Designing and Implementing Critical Thinking Instruction through Video-Based Training: A Case Study

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Abstract

Critical thinking skills (CTS) have never been discussed as main topic in science teachers training. Negative issues on teacher training have triggered researchers to look for other alternatives to increase the effectiveness of teacher training. A video-based training (VBT) were expected to overcome these issues. The purpose of this research was to improve teachers' competencies in implementing critical thinking skills instruction through video based training. This research was a case study with four participants of science teachers. A video package, contains 33 video segments, was learned by teachers every day within 5 weeks via google classroom. These videos were divided into four main topics: (1) explanation of CTS, (2) designing, (3) implementing and (4) assessing CTS instruction. Participants had to complete assignment after they learned videos on each day. They were guided by a coach who was responsible for managing training activities, providing assistance and giving feedback on their assignments. Teachers' lesson plan, students' worksheets and evidence of learning implementation were collected before and after VBT. These documents were analysed using three level of scoring rubrics. The results showed that teachers' competencies on designing and implementing CTS instruction were increased. However, there were some problems during the implementation. Teachers' have difficulties in integrating CTS into the science topic, as well as the discrepancy between lesson plan and its implementation. Limitation and recommendation for improvement also were discussed in this article.

Keywords: Video based training, critical thinking skills, instruction, teacher, competencies.

Introduction

Critical thinking is one of four learning skills required in 21st century (Triling & Fadel, 2009). It is a core life skill, considered as the highest mental activity (Seyithan, 2015; Smith, 2002). Science learning standards such as the National Science Education Standard (NSES) or Next Generation Science Standard (NGSS), emphasize the importance of students to think critically in solving problems (Zohar, 2004). The demand for critical thinking is also reflected in the Graduate Competency Standards document for middle school level in Indonesia, especially in the skills dimension. This standard requires students to be able to think critically so that they can use empirical evidence as a basis for decision making (Kemdikbud, 2016). Several studies have shown an overview of critical thinking skills of Indonesian students. Middle school students' skills are still very low in analysing (Dewi & Utami, 2019), formulating problems (Hidayati & Sinaga, 2019; Santika et al., 2018), alternative problem solving solutions (Nisa et al., 2020), formulating strategies and tactics (Puspita

et al., 2017), and making conclusion (Elisanti et al., 2018). The results of those studies indicate that Indonesian students need to be trained to develop their critical thinking skills.

Critical thinking skills cannot develop by students themselves, it must be taught (Black, 2005). Teachers must be able to develop learning activities that can engage students in thinking, provide various strategies for developing thinking skills, and train them continuously (Beyer, 1987). Therefore, teachers must have critical thinking skills (Smith, 2002), as well as knowledge and experiences on teaching these skills (Birjandi & Bagherkazemi, 2010; Rudd, 2006). However, teachers still do not know what critical thinking is and how to teach this skill in their classroom. Teachers are not familiar with the definition of critical thinking (Alazzi, 2008), they have lack of knowledge and skills about critical thinking (Mohd Hisham et al., 2017). Teachers are not able to integrate 21st century skills in the learning process (Jufri et al., 2018) and this factor is one of the biggest obstacles in teaching critical thinking skills (Aliakbari & Sadeghdaghighi, 2013).

Behar-Horenstein & Niu (2011) argue that the teacher training and experiences in teaching critical thinking affect the improvement of students' critical thinking skills. Teachers need professional development activities that can increase their pedagogical knowledge and provide support and assistance in teaching critical thinking skills (Zohar, 2007). Workshop is one of the most frequently conducted forms of teachers professional development (Garet et al., 2001). This activity involves expert instructors and participants attending the scheduled meeting sessions. Although this form of activity is very frequent, many expert and professionals have criticized that this activity is not effective (Darling-hammond, 1995). Activities and content in workshop are not sufficient to increase teacher knowledge and to encourage change in their teaching (Loucks-Horsley et al., 2010). In addition, workshops also require significant funds for trainers, participant accommodation costs, and participant honoraria, especially if the workshop is conducted in large numbers of participants (Basen-Engquist et al., 1994). In Indonesia, workshops are often held by taking teacher teaching time or held during teacher working hours for 3-5 days. Teachers' work is neglected and student learning is also disrupted (Prihastuti & Widodo, 2019; Widodo & Riandi, 2013).

The use of technology today is very important along with the shift in face-to-face learning in the classroom towards digital learning. Video becomes a new dimension as part of teacher professional development activities. Even though the initial production costs of video are large, it will be efficient enough if used for training with a large number of participants (Basen-Engquist et al., 1994). The use of video is proven to be effective in bridging the theory into practice of learning in the classroom (Major & Watson, 2018). Videos provide a more concrete overview of teaching practice than simply reading from written sources (Hiebert et al., 2002). Video products can be stored digitally with a large capacity which make it possible to be played back at any time (Brunvand, 2010). However, no matter how good the material is delivered through workshops or videos, it won't make any difference if the teachers are unable to implement them in their teaching and learning process. In fact, this is the most crucial point in teachers' professional development activities. Therefore, there must be a long-term teacher professional development activities with mentoring and coaching in bridging theory from training into classroom practices (Garet et al., 2001). Darling-Hammond (1995) argues that this kind of activities is more responsive to meet the teachers' needs.

To overcome these issues, we are inspired to develop teacher training activities which can meet those needs. Bearing in mind the effectiveness of using video in teacher training as well as the efficacy of practicing mentoring and coaching to assist the teachers in implementing new knowledge, video-based training and coaching activities were designed. The purpose of this study was to explore the implementation of video based training which can improve teachers' competencies in designing and implementing critical thinking instruction.

Materials and Methods

A case study was used to explore the competencies of participants in designing and implementing critical thinking instruction after participating in video based training. This study begins with developing video content as the main media used in this training. The variable observed was teacher competencies in designing and implementing CTS instruction in science subject.

Video content and development

The script design and video production were carried out from December 2019 to September 2020. This processes involved two professors to provide advices on the accuracy of the material presented in the video. The video was also validated by 2 experts to get suggestions for improvements related to the adequacy and suitability of materials, the appearance of animation and text in the video, and the ease of understanding the video content. The video was divided into 4 main topics: (1) types of CTS, (2) designing critical thinking instruction, (3) implementing critical thinking instruction, and (4) assessing CTS. CTS refers to critical thinking indicators initiated by Ennis (1987b). Topic 1 consists of 8 segments, containing introduction of CTS and explanation of 8 CTS. There were eight CTS explained in the video, namely: (1) Focusing on questions, (2) Analysing arguments, (3) Asking and answering questions, (4) Judging the credibility of sources, (5) Making and judging observation, (6) Making and judging deduction & induction, (7) Identifying assumption, and (8) Deciding on action. Topic 2 consists of 8 segments, discussing how to practice eight CTS in science instruction including how to develop CTS lesson plan. Topic 3 consists of 5 segments, which describes the implementation of CTS using 5 learning methods, namely: classroom discourse, experiment, discussion, problem-based learning, and project-based learning. Topic 4 consists of 9 segments, which explains how to develop CTS assessment, as well as examples of questions that measure eight CTS. The duration of each segment ranges from 3 to 8 minutes.

Participants

Prospective participants, who never received training on CTS, were invited to online meeting which held by one of the science teachers' forum. The mechanism of VBT was explained by first researcher. Those who interested in participating in this training were asked to fill in the registration link and joining in google classroom using class code given. Initially, 10 science teachers were participated in this training. However, only four teachers completed all activities while 6 others were quit on third week. The participants are from four public school in Banten Province, Indonesia. They have more than 10 years' experiences in teaching science subject in middle school. This article will discuss the development of these four teachers' competencies after participating in video based training (VBT).

Video-based training procedure

Training activities were guided by a coach (first researcher), a teachers' trainer with 10 years' experiences. The coach managed the training and provided assistance to the participants. The schedule for participants is described in figure 1 below. In first day, participants were asked to upload their initial lesson plan document (including the worksheet) and the recording of classroom implementation. On the next day, participants began to study the material from the video uploaded by coach and working for the assignments given until the end of week three. Video materials and assignments uploaded by coach every day at 8.00 AM. The estimated time needed to complete learning video and assignment were 1-2 hours per day depending on the abilities of the participants. Participants were free to access videos and working for assignments anytime, as long it does not exceed the schedule given. Even so, participants have extra time to complete delayed assignments on weekends, such as on day 6th and day 20th.

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Document Uploaded	- Topic 1: S1, S2 - Asg 1	- Topic 1 : S3, S4 - Asg 2	- Topic 1: S5, S6 - Asg 3	- Topic 1: S7, S8 - Asg 4	Assignment finishing	Off
Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
- Topic 2: S1, S2 - Asg 5	- Topic 2 S3, S4 - Asg 6	- Topic 2 : S5, S6	- Topic 2: S7, S8 - Asg 7	- Topic 3: S1, S2	- Topic 3: S3, S4	Off
Day 15	Day 16	Day 17	Day 18	Day 19	Day 20	Day 21
- Topic 3: S5 - Asg 8	- Topic 4: S1, S2, S3 - Asg 9	- Topic 4: S4, S5 - Asg 10	- Topic 4: S7, S8 - Asg 11	- Topic 4 : S9 - Asg 12	Assignment finishing	Off
Day 22	Day 23	Day 24	Day 25	Day 26	Day 27	Day 28
LP	LP	LP	LP	LP	LP	Off
Day 29	Day 30	Day 31	Day 32	Day 33	Day 34	Day 35
IMP	IMP	IMP	IMP	IMP	IMP	Off

Note:
S: Segment ; LPA: Designing Lesson Plan; Asg : Assignment;IMP:Implementation

Figure 1. Video based training schedule.

Participants were given the opportunity to ask questions either through conversations in class chartroom or privately with coach. In the fourth week, they asked to design CTS lesson plan. Once it has finished and examined by coach, they implemented the lesson plans in fifth week. Finally, teachers uploaded all documents and evidence of classroom implementation on google classroom.

Data Collection and analysis

Primary data used in this study were documents of lesson plan and worksheet, as well as the evidence of its implementation before and after VBT. Evidence of learning implementation can be analysed from video recordings or screen capture of learning activities from teachers' online platform. Those documents were analysed and assessed using rubrics. The analyses of initial and final documents were compared to gain an overview of the development of teachers' competencies on designing and implementing critical thinking instruction.

Instrument

The instrument used in this study were participants' assignments. For video topics 1 (assignments 1-4), participants worked on several questions to measure participants' understanding about 8 type of CTS. The purpose of these assignments was to make sure that participants watch the video. Therefore, the results from these assignments were not analysed in this study. After participants studied video topic 2, they were given assignment 5-7 to create a learning activity which integrating each CTS. Assignment for video topic 3, participants were asked to prepare a lesson plan that integrated at least 2 critical thinking skills (assignment 8). In video topic 5, participants were asked to create one question to measure each CTS (Assignments 9-12). In the fourth week, participants were assigned to prepare teaching tools (lesson plans, student worksheets, and teaching materials) which will be implemented in the fifth week.

Other instruments used are rubrics to assess documents of lesson plans, and its implementation. The rubrics using three scores (10, 20, and 30), with a grading criteria for each score. For the lesson plan rubric, the aspects assessed were the formulation of learning objectives, details of learning activities, assessment designs and student worksheets. The rubric for implementation includes aspects of learning activities and relevancy between lesson plan and its implementation.

Results
Teachers' competency in designing critical thinking instruction

The analysis of initial lesson plans of all participants showed that learning objectives and learning activities did not integrate CTS. Only teacher 2 provided the opportunity for students to

think critically by asking her students to make questions in the beginning of lesson. Making questions is basic skill for critical thinking and it is included in the elementary clarification indicators by Ennis (1987a). This cause Teacher 2 has the highest score for initial lesson plan before the training (Figure 2).
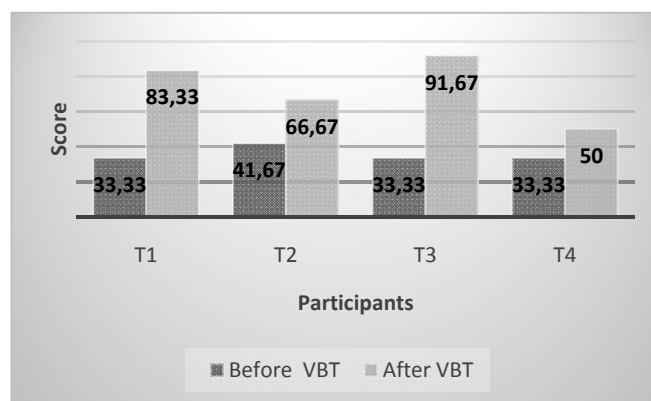
Figure 2. Development of teacher competency in designing CTS instruction

Learning activities of four participants in initial lesson plan, were relatively the same that is teachers are giving topic material to learn and asking students to fill in the worksheet given. Teacher 1 delivers the material by online meeting in her you tube channel. Teacher 2 and 3 preparing power point presentation file containing topic learned and giving those file to their students as reading material. Teacher 4 is giving his students a video file containing explanation of topic learned. After studying material given, students were asked to answer several questions using worksheet. The questions asked in worksheet did not reflect critical thinking at all. Students can easily found the answer from books or internet.

After participating in VBT, the competency in designing CTS instruction has increased for all participants. Learning objectives that describe CTS have been included in their lesson plan. Although the learning activities were still the same as those formulated in initial lesson plan, all participants can integrate CTS in student worksheet. Based on Figure 1, teacher 3 has the highest increasing on designing CTS instruction. She was integrating decision making skill into electronic circuit topic in students' worksheet. The presented issue in worksheet was able to make students learning the concepts and CTS simultaneously. Learning activities in her lesson plan indicating relevancy with learning objectives. However, the learning process described on her lesson plan did not show that teacher explaining or guiding the students about the process of decision making. Students learning by themselves and teacher were not actively involved in the learning process.

Teacher 1 also did a good improvement in designing CTS instruction. The CTS and science concept were interrelated and well integrated. As a result, the learning objectives of students' knowledge and CTS can be achieved simultaneously. Teacher 1 was planning to develop judging the credibility of sources and analysing arguments skills into food additive concept in her learning objectives. Students were given task to analyse information from two articles about food additive by using several questions. Unfortunately, none of the questions related to analyse the credibility of sources. As a result, learning objectives related to judging the credibility of sources were not achieved through this activity.

The description of learning activities of teacher 2 was very detail and accurately in practicing students to make questions and analysing arguments from articles given. However, teacher tend to

concern on attaining target of CTS and ignoring achievement on student understanding about the concept. Consequently, the learning objectives about the concept would not be achieved by this activity. Teacher 4, with the lowest improvement on designing CTS instruction, was planning to integrate deductive reasoning skills into mixture and compound concepts. The formulation of learning objectives was explicitly describing target of knowledge and CTS. In his lesson plan, Teacher 4 was planning to give students a video to learn and worksheet for assignment. The content of video describes the concept and examples of mixture, compound and solution. The worksheet was asked students to classify several samples into appropriate category (mixture, compound or solution). All samples that teacher write in worksheet, were the same sample that presented in video. Students can easily found the answer in video or students' textbook. None of the task that give chance to students to use their reasoning deductively to classify the samples given in worksheet. In addition to this worksheet, teacher also provides another worksheet containing questions that explore students' understanding about the concepts being studied. He seems trying to attain students' understanding about topic and critical thinking skills separately by using two different kinds of worksheets. From this results, it can be concluded that teacher 4 still lack of understanding about how to design CTS activities, as well as integrating it into the topic taught.

Teachers' competency on implementing critical thinking instruction

Before participating in VBT, none of students' activities lead to the development of CTS. Teachers gave students power point files, handouts, or videos related to concept to be learned. There were no questions in worksheet which can train students' critical thinking skills. Not all learning objectives can be achieved during the learning. For example, teacher 1 only achieve one out of three learning objectives from her lesson plan. On the contrary, teacher 4 was better in terms of achieving all learning objectives being planned. After participating in VBT, Teachers competency in implementing critical thinking instruction has increased (Figure 3). Competency of teacher 3 increased by 60 points, followed by teacher 1 by 25.55 points and teacher 4 by 4.44 points. Only teacher 2 got a decreased score of 6.67 points.
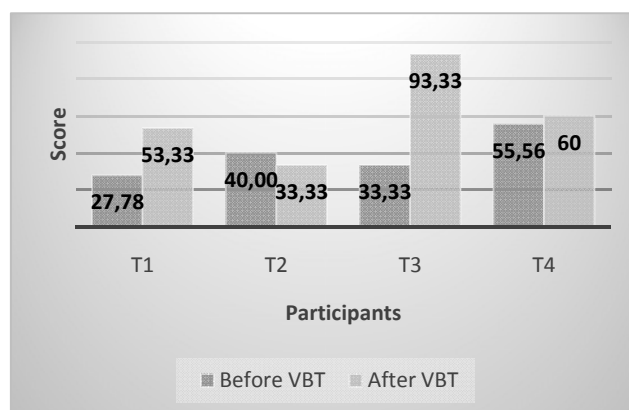
Figure 3. Development of teacher competency in implementing critical thinking instruction

The problems found during classroom instruction were the discrepancy between lesson plan and its implementation, as well as the lack of teachers' ability on integrating CTS into topics taught. For example, at the beginning of the lesson, Teachers 1 and 2 are presenting a picture and a piece of article related to the topic being studied. They used Question Formulation Technique (QFT) to lead students in making questions. They asked students to make 3 questions related to the information pre-

sented. After students succeeded in formulating questions, teachers did not follow up on students' questions. Teacher 1 continues to deliver material about food additives through her YouTube channel, while Teacher 2 assigns students to work on other worksheets. Whereas in the lesson plan designed by teacher 1, students' questions were discussed again with all students to find out their initial understanding of the material to be studied. Meanwhile, teacher 2 planning to select several students 'questions to be discussed by students in groups.

Teacher 1 was better in terms of integrating CTS into the concept being taught. She was using articles which related to the concept and can be explored to train analyzing arguments skills. Teacher 2 only focuses on the achievement of students' CTS but ignores students' understanding about the concept. This causes the low scores obtained by teacher 2. However, learning activities which carried out by teachers 2 were in accordance with her lesson plans. Teacher 4 also has not fully integrated the CTS on the topics taught. Students 'worksheets from teacher 4 are even made separate from the worksheet related to knowledge and CTS achievement.

The integration between concept and CTS that carried out by teacher 3, was better than the other three teachers. The selection of stimulus used in worksheet can help students to gain knowledge and CTS simultaneously. Figure 4 is an example of question in worksheet given by teacher 3. Students' activity in this worksheet is in accordance with learning objectives in teacher's lesson plan. The learning objective was to determine the relationship between the amount of electrical resistance, the length of the conducting wire and the cross-sectional area of the conducting wire. Through this task, students were trained to make decision by considering appropriate criteria in order to solve problems. Thus, students' understanding of topic and decision-making skills can be achieved simultaneously.

Figure 4. Example of student worksheet of teacher 3

Discussion

The results of this study indicate that video based training was able to improve the ability of participants in designing and implementing critical thinking learning. Participants were able to design learning objectives and learning activities with the integration of CTS. However, there was a discrepancy between instruction design and its implementation. Participants were having a hard time to fulfil all learning objectives which they have planned. Students' understanding about the concept and CTS did not achieve simultaneously. Based on teachers and coach conversation in chat room, lack of time and students' participation has become the reasons why teachers' instruction did not optimal. This result is in line with Sampson and Blancahrd (2012) study on the practice of argumentation in classroom, where argumentation discussions take a longer time and teachers need to reach content targets faster to prepare students for exams. Teachers are more concentrated on curriculum

achievement targets so that other factors are neglected, such as students' skills in identifying problems, making questions to search information and conducting research to solve problems (Chin et al., 1994).

All participants were using online learning during the implementation. Three of participants were using WhatsApp messages as learning tool. It was hard for them to explain synchronously about the concept and CTS due to lack of devices that students have in their home. As a result, student learning activities are only limited to study material provided by teacher and working on worksheets individually. The same condition was also expressed by other research that the main obstacles in distance learning are students learning devices and internet access (Rasmitadila et al., 2020; Sikirit, 2020). Teachers must have varied strategies to motivate students during online learning.

The other positive outcome from this study is participants were able to create questions that practice some of critical thinking skills. After all, participants need to pay attention to the achievement of students' conceptual mastery in addition to the target of achieving critical thinking skills. They have to create questions that accommodating science concept and CTS as well. According to these problems, participants need more practicing to integrate CTS into their instruction so that students can understand science concepts, as well as mastering targeted critical thinking skills. Duschl & Gitomer (1997) stated that the success of teachers in facilitating learning and assessment, requires a clear understanding of the teacher about the concept being explored. Adequate knowledge of content and pedagogy will assist teachers in designing more effective learning and assessment (Jones & Moreland, 2005). Harlen & James (1997) argue that teachers will not be able to make assignments to monitor the development of students' skills if teachers do not clearly understand these skills. When teachers understand the characteristics of the skills that will be trained to students, they will more easily identify the goals to be achieved in learning, including measuring them (Ennis, 1993; Paul & Elder, 2005). Teachers who have conceptual and procedural knowledge, enable them to choose more suitable tasks that can develop students' potential (Jones & Moreland, 2005).

This study also indicates that the use of video plays a role in teachers' knowledge and understanding of instruction design which develop students' critical thinking skills. Previous studies also revealed that videos are proven to improve understanding of the material being studied (Kay & Kletskin, 2012; Mitra et al., 2010; Sever et al., 2013). Video provides a more concrete picture than just reading from a written source (Hiebert et al., 2002). The participants also revealed that for difficult material, they could play the video 3-5 times. The use of video is recognized as being able to facilitate learners to be able to access materials and manage their learning independently (Vogel & Klassen, 2001). Learners are challenged with full responsibility to control the process of discovering their own knowledge and skills. They can set the pace and focus of learning and adjust it to the time they have.

However, there were still many obstacles found in the implementation of this video-based training. This training takes longer time than face to face workshops. It becomes a huge challenge for teachers to remain consistent in participating until the end of training. Even though it doesn't take a long time to study the material and do the assignments in a day (±2 hours), participants found it difficult to provide time to do those activities. Teacher 1 complaint that too many videos and assignments they have to study in a day in the first week (Table 1). Based on that complaint, videos and assignments were reduced in the second week and it becomes only 2 videos were studied in a day, as well as the assignments. However, this does not change participant's discipline in completing their tasks. Many of participants completed the tasks outside the schedule. Teacher 4 were not active after the first week and re-engage after the training had passed 2 weeks. Chyung et al. (1998) also found that distance learning made participants burdened and failed to adapt to the new environment.

Teachers have a lot of teaching burdens so they find it difficult in providing time to participate in professional development activities (Gaible & Burns, 2005).

Another limitation was participants have to learn on their own through videos and cannot connecting with other participants to discuss and sharing their works. It is in accordance with Bullen (1998) study, where some participants in online lectures felt more comfortable when learning was done face-to-face because they could have real discussions with their peers. However, in this training, participants were given the opportunity to ask with coach directly via chat or email about their difficulties in doing the assignment or understanding the materials from video.

According to the participants, designing critical thinking lesson plan and assessment were new experiences for them. Participants were struggling to design their own critical thinking lesson plan and assessment. They tend to imitate the example presented in the video for their instructional design. Although the material chosen by participants was different from the video examples, the steps for learning activities and the type of questions were similar with the examples. Similar result also found by Hollingsworth (1999) who revealed that all trainees practiced the same examples and strategies as those given during the training. However, not all teachers can immediately master the skills just by looking at examples. The more complex the new skills learned, the more difficult for teachers to transfer those skills into real practice (Joyce & Showers, 1980). Creating critical thinking questions is new skill for all participants, they still have difficulty in understanding and practicing it. This opinion was reinforced by Zohar (2007) which states that when teachers find learning materials that they are not familiar with, they have no choice but to adopt the examples provided. As a consequence, they produce shallow understanding about the skills and did not comprehend the main point. To improve the teacher's understanding, participants need to do more practices to design CTS lesson plans and its assessments. One of the important components for effective teacher training is the existence of a continuous activity, where teachers receive mentoring support in implementing new skills in real practice in the classroom (Garet et al., 2001; Korthagen et al., 2006). This training has attempted to provide many examples through videos and mentoring to implement new knowledge. However, participants still need more practice so that they can apply their knowledge well in designing learning and critical thinking assessments.

To overcome the problems from VBT implementation, several improvements need to be made for future. Formal legality from head of Education Board is required to improve teachers' commitment and discipline. Teacher training which is known and supervised by super intendent from education Board as teachers' supervisor, might encourage teachers to be fully committed in participating the training. The amount of materials and assignments also need to be rearranged, so teachers have more time to do their assignments in each day. Teachers who have not completed the assignment, should not get the next material and assignment until they are able to complete their previous task. A more intensive mentoring process is needed in the preparation of lesson plans and its implementation. Teachers need to practice on designing and implementing lesson plans for at least 3-4 lessons. In order to further strengthen the teacher's understanding of the material and assignments, face-to-face online meetings need to be held at the end of each video topic, so the participants can share and discuss the difficulties during the time learning and their works as well. This research still needs to be continued by doing a scale up on the number of participants so that it can be calculated statistically about the effectiveness of video based training. In addition, the diverse of participants from various ages and work experiences, can be an opportunity for further research. The shortcomings found in this study can be used as improvements to the video content so that participants get a better understanding of critical thinking instructions and its implementations.

Conclusions

Video based training can be an alternative way in teacher professional development activities to increase teachers' competencies in designing and implementing CTS instruction. A video package and coach have been prepared to train teachers in delivering science instruction which develop students' critical thinking skills. Before the training, none of participants implementing critical thinking skills in the lesson plan documents or in their classroom. After participating in VBT, participants were able to develop critical thinking skills lesson plan. Even though, participants were struggling to design their own critical thinking lesson plan and assessment. In the implementation phase, teachers still have difficulty in integrating critical thinking skills into the topics taught. Learning objectives from teachers' lesson plan cannot optimally achieved. Limited time and teaching strategies during online learning were the biggest obstacles in implementing teachers new skills from VBT. Teachers need more intensive assistance in implementing critical thinking learning so that this training can have a direct impact on students' knowledge and critical thinking skills as well.

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