

Using a Video-Based Approach to Develop Pre-Service Science Teachers' Understanding of How to Teach the Nature of Science

Kennedy Kam Ho Chan, Anthony Ka Lok Cheng, Carol Kwai Kuen Chan, and Benny Hin Wai Yung
kennedyckh@hku.hk, chengkla@hku.hk, ckkchan@hku.hk, hwyung@hku.hk
The University of Hong Kong

Abstract: This study examined if and how the dialogic discourse triggered by viewing multiple authentic classroom video footage arranged in themes enhanced pre-service science teachers' (PSTs') PSTs' understanding of the explicit-reflective approach. The findings suggest that the PSTs made use of several sense-making strategies to interpret the various classroom enactments of the explicit-reflective approach captured in the video clips. This in turn led to new ideas and understandings of how the explicit-reflective approach could be best implemented in actual classrooms.

Introduction

Enhancing students' conceptions of the nature of science (NOS), their cognitive understandings of the enterprise of science and the nature of scientific knowledge, has been regarded as essential to their scientific literacy. Arguably, efforts to promote contemporary views of NOS among learners are largely unproductive unless teachers' understanding of how to provide quality NOS instruction is first enhanced. Despite this, fewer studies have described how to effectively enhance PSTs' understanding of the specific pedagogy for teaching. Among the small but growing number of studies, few have used authentic classroom videos to enhance PST learning. Hence, few details have been available in the literature on how videos can be used to enhance PSTs' understanding of NOS-specific pedagogy in teacher education activities. This study aims to fill this gap by exploring the use of a video-based approach to improve PSTs' understanding of the instructional approach most germane to effective NOS instruction, that is, the explicit-reflective approach (Akerson, Abd-El-Khalick & Lederman, 2000). We engaged the PSTs in dialogic discussions of multiple authentic classroom video clips arranged in a series by themes (e.g., concluding a lesson on NOS). Our research question is: In what ways does dialogic discussion triggered by exposure to multiple authentic classroom video clips provide opportunities for PSTs to discuss different ways of using the explicit-reflective approach in NOS instruction?

Methods

Context of the study

Ten science PSTs seeking certification to teach high school science voluntarily participated. They attended two three-hour teaching sessions on teaching NOS conducted by the teacher-researcher (the first author).

Pedagogical design

Watching multiple authentic classroom videos in a series: The PSTs watched authentic classroom video footage selected and edited from the video archive of a prior local professional development. Short video clips (<5 minutes) were organised for presentation by sorting them into themes (e.g., introducing students to NOS, concluding a lesson on NOS). These short video clips were presented successively with a brief pause in between.

Dialogic discourse: After watching a series of teaching videos, open-ended prompts (i.e., (1) What did you notice in the videos?) were used to elicit the PSTs' opinions of them. The students' views and collective consensus were made visible on a large whiteboard.

Methods

Multiple data sources include (1) videos of the two lessons (three hours each) and (2) exit reflections of the PSTs. We identified the turns in which the PSTs commented on more than one video in the lesson transcripts. Codes were developed to characterize the strategies the PSTs used to make sense of the video clips using the constant comparison method. The transcripts were then searched for instances in which the PSTs discussed different ways of implementing the explicit-reflective approach and codes were developed to characterize their understanding through inductive analysis of the transcripts and the exit reflections.

Findings and discussion

Below is one illustrative example of the video-mediated dialogic discussion.

- 1 Teacher: Anything you noticed? And you want to share with us? (Wait 3s) Yes, Kathy.
- 2 Kathy: I think Teacher A [*Video A*], Ms Chow [who used] only 1 sentence [to describe the goal of the lesson] is too simple. It is too abstract for students to get a quick concept of what science is. But for, I think evolution, Mr Tam [i.e., *Video B*], he tries to compare the two sentences to tell what science is and it is more practical. ...
- 3 Teacher: It seems that you don't agree with Fred's idea. Fred mentioned that it is good to simplify the key term, but then you think, probably, it is not that desirable to simplify too much ... What is the purpose of investigating or exploring the two cases [in *Video B*]?
- 4 Tom: He pointed out there're two aspects of NOS. He wanted them [the students] to know which is theory, the nature of theory and law. And then the other case was how we can generate scientific knowledge without doing experiments.
- 5 Teacher: Yes, Carrie.
- 6 Carrie: I like *Video B* [i.e., Mr Tam's video] and [*Video*] *E* because what the point is talking about with NOS is related to the content of the lesson. But, for [*Videos*] *A*, *C* and *D*, it seems like the lesson is just on NOS, but because NOS is supposed to be taught for every topic, so I don't agree that they should just start the lesson like, this is a lesson about NOS
- 7 Teacher: Any more that you want to share with us? Any more that you noticed?
- 8 Tom: Ms Tam [in *Video E*] was, I think, the only one who started with an example and then ask students to infer the NOS from the example of the food pyramid. So... so that it's kind of opposite to what Mr Tam [in *Video B*] did, which is to list out the aspects of NOS. But then, in [*Video*] *E*, Ms Tam asked... so the students arrived at the conclusion themselves.

In Turn 1, one of the PSTs, Kay, compared and contrasted two videos within the series of videos and identified two different ways of introducing the lesson goals in an NOS-focused lesson. The teacher-researcher co-ordinated the discussion by contrasting the ideas without imposing any judgement (Turn 6). He then prompted the PSTs to consider the rationales underpinning the teacher's actions in *Video B* (Turn 3). This question led the PSTs to realize the connection between the lesson's activities (i.e., examining historical cases related to evolution) and targeted aspects of NOS (i.e., scientific theory and laws, empirical NOS) as evident in Tom's utterance (Turn 4). This discussion of integrating the teaching of science content with aspects of NOS further motivated Carrie to *spontaneously* express a new idea (Turn 6). Carrie *categorized* the five videos into two different groups (i.e., situated NOS instruction and VS non-situated NOS instruction). After highlighting the differences between the two groups of videos by Carrie (Turn 6), Tom further expressed his views on one of the groups. The strategies used to interpret the videos included identifying *Video E* as an "odd man" (Turn 8) evidenced by Tom saying that the teacher in *Video E* "was the only one" adopting a certain approach to teaching. He then went on to *contrast* this video with *Video B* from the video group previously identified by Carrie. From there, he brought up a new idea, that there were at least two different approaches (i.e., inductive and deductive) to embedding NOS into science content teaching. This opened up further discussion on how best to conduct an NOS lesson in which the teacher overtly makes the aspects of NOS visible to the learners.

Conclusion and implications

The data suggest that exposing PSTs to thematically-arranged video footage can potentially deepen their examinations and interpretations of the explicit-reflective approach. We also illuminated several sense-making strategies the PSTs used to interpret videos viewed in a thematic manner (e.g., comparing videos, categorising videos, odd man), thereby contributing to the literature on the use of video in teacher education.

References

- Akerson, V. L., Abd-El-Khalick, F., & Lederman, N. G. (2000). Influence of a reflective explicit activity-based approach on elementary teachers' conceptions of nature of science. *Journal of Research in Science Teaching*, 37(4), 295-317.