Scaffolding Learning from Contrasting Video Cases

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Abstract: Video cases can serve as valuable instructional tools for preservice teachers by presenting examples of effective and ineffective student learning and pedagogical approaches. However, merely seeing video-cases without in-depth, interpretive analysis may not ensure learning. This study examined the effects of *cognitive, metacognitive, combination, and affective questions*, on preservice teachers' declarative knowledge of formative assessment, case-interpretation skills and ability to redesign formative assessments in similar and novel classroom contexts. All participants showed significant improvements from pretest to posttest on declarative knowledge and case-interpretation skills. A-priori planned contrasts revealed that the cognitive-questions group outperformed the metacognitive group on declarative knowledge whereas the metacognitive-questions group outperformed the cognitive group on video case-interpretation at posttest and transfer tasks. The results suggest practical implications for using specific scaffolding questions that are effective in improving conceptual knowledge and applied case-interpretation skills during contrasting video case analysis activities.

Introduction

There is a growing interest in using video cases as instructional tools in preservice teacher education (Cannings, & Talley, 2003). Video cases can serve as a feasible means to support teachers in learning about classroom practice. Video provides a dynamic medium to present authentic cases of teacher instruction, student learning, and classroom interactions. Video cases that are *contrasting* to one another may further enhance learning by supporting the development of well-differentiated knowledge of concepts and their relevance in different settings. The task of analyzing a single video case, however, is complicated, leave alone analyzing contrasting video cases. Not only do preservice teachers have to identify relevant aspects of a teaching situation, understand the specific context and integrate conceptual knowledge they might have with the classroom interaction they are viewing, but they also need to identify the similarities and differences between the contrasting video cases (van Es & Sherin, 2002).

An earlier study revealed that analyzing contrasting cases without any guidance resulted in lower conceptual understanding than repeated viewings of a single case (Nagarajan, Chernobisky, & Hmelo-Silver, 2004). Therefore, it is essential to find effective ways to support preservice teachers' learning from contrasting video cases such that we can minimize cognitive load, direct focus on target concepts, and facilitate the connection between theoretical knowledge and practical applications. Scaffolding prompts or questions are one possible way to guide video case analyses. However, there is little research about the effects of specific types of questions that positively facilitate learning from video case analysis activities.

In this study, we examined the use of contrasting video cases in the context of formative assessment. Formative assessment has consistently shown positive impact on student learning and has been identified as an extremely important component in preservice teacher education (Black & Dylan, 1998). This study explored the effects of different types of scaffolding questions on preservice teachers' learning of formative assessment principles, as they analyzed contrasting video cases.

The conceptual framework for this study was grounded in the cognitive apprenticeship model of learning whose three main processes of modeling, coaching and scaffolding are intended to help students acquire necessary cognitive and metacognitive skills as they engage in a learning task (Collins, Brown, & Newman, 1989). Preservice teachers learn by noticing and analyzing video cases of what other teachers do in their classrooms. The teacher in the video case serves as the model performing a task. Preservice teachers can construct their own understanding by observing the model teacher, interpreting what worked and what did not, internalizing relevant knowledge, and applying that in other relevant contexts. Coaching is provided to the preservice in the form of task structure and

scaffolding prompts. Preservice teachers receive scaffolding in the form of question prompts as they engage in these complex video case analysis activities.

Learning from Contrasting Cases

Case based learning affords opportunities for understanding a principle in context of an authentic situation. However, a single case may not be sufficient to capture the complexities of certain concepts and lead to over-contextualized knowledge, and thereby hinder transfer. Transfer occurs when a person applies principles and concepts learned in one situation to solve a new problem. The *preparation for future learning* perspective on transfer (Bransford & Schwartz, 1999) suggests that cases prepare people to learn and subsequently apply their understanding in other contexts. Providing a contrasting case prompts them to make comparisons, and may help them identify more elements than if they watched a single case. In addition, if concepts are learned in this contextualized and applied fashion, it is more likely that they will remember and apply these concepts to different cases in other situations. For transfer to occur, the learner must have deep conceptual understanding of the relevant concepts and principles and be able to flexibly modify and apply them in new contexts. This type of flexible application is possible only when one has learned about the concepts in multiple contexts.

Why Video Cases?

Preservice teachers may benefit immensely by participating in video analysis activities that focus on integrating principled theory with contextual practice (Derry et al., 2005). After all, the main goal of teacher education programs is to provide students with the necessary conceptual knowledge that can be flexibly applied in practical classroom settings. Video cases can bridge the gap between theoretical principles learned in teacher education courses and actual classroom practice by presenting examples of effective as well as ineffective practice in different classroom situations (Cannings & Talley, 2003). Video cases have several advantages over text-based cases in terms of the amount of information they convey as well as their ability to portray non-verbal information such as facial expressions, voice intonations, gestures, environmental dynamics and so on. In addition, video cases present a complex portrayal of incidents and events as they present an authentic scenario unlike text-based stimuli that may be comparatively simpler and artificial.

van Es & Sherin (2002) examined how video cases could be used to help preservice and in-service teachers *notice* what was happening in their classrooms. Although the authors acknowledged the need for teachers to be able to attend to ideas brought up by students and flexibly adapt their teaching, they emphasized that this was not an easy task and teachers needed some sort of support to help them in this process. Specific examples of support were not discussed or examined in this study. Owing to the dynamic differences between text-based and video-based cases, one must be cautious in over-extending the results from studies on text-based cases to contexts where video cases are used. The potential advantages inherent in video cases might actually make them a more challenging tool to use in teacher education, therefore requiring additional guidance or scaffolding.

Role of Scaffolding on Learning

Researchers have discussed the importance of providing preservice teachers with suitable viewing "lens" to make learning from video cases an effective, meaningful experience (Abell, Bryan, & Anderson, 1998; Fong, Percy, & Woodruff, 2004; van Es & Sherin, 2002). Preservice teachers need guidance with respect to specific concepts they should focus on, questions to enable meaningful interpretations, and collaborative discussions.

A comparison of 11 preservice and 11 experienced elementary teachers was conducted with respect to what they noticed from exemplary video vignettes on astronomy instruction (Fong, Percy, & Woodruff, 2004). Analysis of think-aloud protocols were categorized into one of four viewing lenses: a) content lens referred to the subject matter in the video, b) form lens referred to identification of technical events such as classroom management, c) pedagogy lens referred to viewing the teacher as a master, with the instructional approach and strategies as the primary focus, and d) surface-level media lens, which referred to comments on the presentation and quality of the video. The results revealed that preservice teachers made significantly more content lens statements than experienced teachers who made significantly greater number of pedagogy-lens statements. The most interesting finding, however, was that both preservice and experienced teachers who were explicitly asked to look for "pedagogically sound teaching principles" did exactly that (p. 4). Providing explicit instructions can therefore elicit appropriate video case analysis behaviors.

Embedding question prompts is a scaffolding strategy that has been used extensively in research (Hmelo & Day, 1999). Questions can help the learner focus on contextual cues, help in organizing thoughts, or perhaps trigger self-reflection and access of prior knowledge that might be relevant and useful to the given task. The Knowledge Integration Environment (KIE) is an example of a scaffolding environment (Davis, 2003) whose goals include: making student thinking visible, identify models of scientific phenomena that connect to a student's prior knowledge, provide social support for peer learning, and encourage students to become autonomous and self-regulated learners. Students may or may not engage in this task unless explicitly prompted to do so. Davis (2003) compared the effects of content-specific and generic prompts on student reflection and found that the generic prompts produced more coherent understanding than the directed prompts.

While many studies describe different types of questions to scaffold student learning, there is little empirical evidence on the effects of specific prompts to support video case analysis activities among preservice teachers. van Es & Sherin (2002) designed VAST (Video Analysis Support Tool) to support teachers in observing and interpreting classroom interactions via video cases.. Six of the 12 intern teachers participated in three 1-hour training sessions doing video case analysis using VAST, in which teachers were prompted to comment on three aspects of instruction: student thinking, teacher's role, and discourse. Teachers analyzed the video cases by responding to a general "what do you notice?" question. They were then provided with sequential prompts that asked them to identify a noteworthy event, provide evidence from the case to justify the importance of the event, and then interpret the event. Results of the study revealed that all six experimental teachers reached the highest scoring level on their second reflective essay as compared to only two teachers from the control group. The authors concluded that experience with VAST helps teachers organize their analysis of events, identify relevant evidence to support selected events, and make meaningful interpretations. A brief intervention with a scaffolding tool helped teachers refine their ways of noticing and interpreting events in a video case. There was however, no indication on whether the scaffolds in VAST work synergistically to support this development or whether specific types of prompts were more influential.

Berthold, Nuckles, & Renkl (2004) investigated the effect of different types of questions on the quality of learning protocols written by 84 undergraduate psychology students after watching a videotaped lecture. One group received only cognitive prompts, another received metacognitive prompts, a third received a combination of cognitive and metacognitive prompts and a control group received no prompts. Results showed that students in the cognitive prompts or mixed prompts group outperformed the control group on the amount of cognitive activities in the learning protocols. Similarly, the metacognitive prompts groups and mixed prompts group outperformed the control group on the amount of metacognitive activities in the learning protocols. Clearly, specific prompts fostered appropriate condition-specific cognitive and metacognitive activities. The question that arises is whether similar results can be obtained by using similar prompts in video case analysis activities. There is no empirical research that has studied the effects of cognitive and metacognitive prompts, similar to the ones used in this study, in video case analysis activities.

Purpose of the Study

The purpose of this study was to compare the effectiveness of four questioning techniques on preservice teachers': a) declarative knowledge of formative assessment, b) ability to interpret video cases for incidence of formative assessment, and c) ability to apply that knowledge in redesigning suitable formative assessments for familiar and novel classroom scenarios.

Method

Participants

Participants were 81 students enrolled in an undergraduate course, *Introduction to Educational Psychology*, at a large Northeastern University. They were offered 4 course credits and $ 20.00 for their time and participation. Participants were predominantly female (n=66), in their junior year (n=51), and mostly white (n=65). Of all 81 participants, 52 reported having some teaching experience and 62 expressed an interest in pursuing teaching.

Design of the Study

This study implemented a repeated measures four-group design. Time was the within-group factor. The between-group factor was the questioning condition that had four levels. The co*gnitive-questions* group received questions related to formative assessment that were task-specific, context-specific, factual, and comprehension-

based. For example: *What are the similarities and differences in how the two teachers test students during a learning activity and at the end of an activity?* The *metacognitive-questions* group received high-level thinking questions that were more general, context-independent, and require reflection, self-monitoring, and self-evaluation. For example: *How will I know whether students really understand the concept as they participate in a learning activity and at the end of the activity?* The *combination-questions* group received both cognitive and metacognitive questions to guide their case analysis. The *control* group received a set of neutral and affective questions. For example: *How are you feeling right now?* Participants in each condition answered a total of six questions specific to their condition in order to control for time on task.

Instrumentation

The entire study was conducted in a customized online learning environment, STELLAR, a "Sociotechnical Environment for Learning and Learning Activity Research" (Derry et al., 2005). Four different versions of the system were developed to cater for each condition. Participants were randomly assigned to one of four conditions in Session 1 and completed all activities online.

Understanding of formative assessment was measured at pretest and posttest in terms of declarative knowledge and video case analysis ability. Declarative knowledge was measured based on responses to a 10-item multiple-choice test and 3 open-ended questions: *what is formative assessment, why is it important,* and *give an example of how you would implement it in a classroom*. Case analysis was measured in two parts: case-interpretation and case redesign. All participants saw two contrasting video clips at pretest and posttest. The 1st teacher referred to tests as a way of assessing knowledge while the 2nd teacher engaged students in hands-on activities and questioning to facilitate learning and provide evidence of student understanding. For case-interpretations, participants described their initial observations and made inferences about the assessments used by the two teachers. The case redesign required participants to apply their understanding to make practical recommendations of formative assessments to be implemented in one of the two classrooms. As part of a transfer task, participants saw two novel video cases, completed a case-interpretation task and recommended redesigns for both cases.

Procedure

The study was conducted across 3 sessions. In Session 1, all participants logged into the online system and were oriented to the system after which the researcher showed two short video cases to the entire group using a projector. Participants then completed the pretest tasks and a demographic survey.

Session 2 was held one week after Session 1. Here, all participants saw a set of training video cases, conducted an unscaffolded comparison of the two cases, reviewed information on formative assessment, and then engaged in scaffolded case analysis activities by answering questions specific to the condition they were assigned to. After completing a brief distracter task, all participants viewed the pretest video cases again and completed a posttest case analysis and redesign. In Session 3, held a week after Session 2, all participants viewed a set of novel video cases and completed a transfer case analysis and redesign.

Scoring

The responses to all open-ended questions, declarative knowledge and case redesign, were coded using a set of predefined formative assessment criteria. A total of nine features were identified and used to define the coding criteria for formative assessment features. For instance, criteria 1 and 2 focused on the purpose of formative assessment: "*Monitors student progress, check student understanding & misunderstanding"* and "*Adjusts instruction to meet student needs and/or repair student misunderstanding"*. Criteria 3 and 4 dealt with timing and frequency of formative assessment: "*Assessment will be carried out during a unit or activity"* and "*Assessment will be carried out a number of times during unit/activity/course"*. In addition, examples of formative assessment were coded into five different categories such as: *i) weekly tests & quizzes, ii) assessment via hand-on activities, iii) informal oral question and answer sessions either individually or in groups, iv) written essays or paper, and v) other examples such as daily homework, presentations, journaling* and so on.

After identifying a particular feature in a participants' response, the responses were further classified as, i) merely a suggested idea, ii) an elaboration of the idea, and/or iii) an explanation how that idea related to assessment and learning. If the feature was merely suggested as an idea without any detailed description or justification, it was

scored as 1 point. For example: "*I would use daily homework to assess student progress"*. If the response provided a detailed description of the idea such as: "*I would assign homework daily that consisted of questions that asked for basic facts and questions that asked students to explain their thinking"*, it was coded as an elaborated idea and scored an additional 2 points (i.e. 3 points for an elaborated idea). If the response further provided an explanation, it was scored an additional 4 points (i.e. 5 points for a justified and well-explained idea); for example, "T*he experiments give a way to expand the students' grades while the oral prompts can be a simple way of gauging understanding without assigning an actual grade"*. If a response included an idea, an elaboration, and an explanation of a specific formative assessment feature, the response was credited for each of them (i.e. a total of 7 points). The total composite score reflected the cumulative score of all features identified and discussed at each task taking into account the depth of the response in terms of ideas, elaborations, and explanations. Using this scoring procedure, three composite scores, for declarative knowledge, case-interpretation skill, and case-redesign skill, were computed for pretests and posttests. In addition, case-interpretation and case-redesign scores for the transfer task were also computed. To ensure and reliable coding, two raters scored twenty-percent of all qualitative responses. The overall percentage agreement between the two raters was 91% across all tasks.

Results

A set of three repeated measures analysis of variance (ANOVA) was conducted with time (pre-post) as the within-subjects factor, treatment group (3 scaffolding questions and 1 control group) as the between-subjects factor, and the three measures of understanding as the dependent variables. Separate ANOVAs were conducted for the two transfer tasks. Each ANOVA was followed by a set of three orthogonal planned-contrasts tests to examine differences between (a) the treatment groups and the control, (b) the single-questions groups (cognitive- and metacognitive-questions group) and the control, and (c) the cognitive- and metacognitive-questions group.

Descriptive statistics for all pretest, posttest and transfer scores are shown in Table 1. Results of the repeated measures ANOVA revealed a significant main effect of time with significant pre-post improvements in declarative knowledge: F (1, 77) = 5.75, $p < .01$, and case-interpretation skills: F (1, 77) = 17.35, $p < .01$, but a significant decline in case redesign skills: F (1, 77) = 13.31, $p < .01$.

The condition by time interaction for case-interpretation was significant, F (1, 77) = 5.73, $p < .01$. Simple effects analysis of pre-post mean scores revealed a significant improvement in pre-post scores for the metacognitive: F (1, 77) = 13.40, $p = .01$, and the combination-questions group: F (1, 77) = 21.40, $p = .01$. Planned-contrasts analysis revealed that the treatment groups significantly outperformed the control group on case-interpretation scores: F (1, 77) = 9.71, $p < .01$. The comparison between the treatment groups and the control group was not statistically significant for declarative knowledge and case redesign scores. Interestingly, the planned contrast comparing cognitive- and metacognitive-questions group revealed that the cognitive-questions group showed greater improvement from pretest to posttest than the metacognitive group on declarative knowledge: F (1,38) = 5.34, $p < .05$. However, the metacognitive-questions group outperformed the cognitive-questions group on video case-interpretation: F (1, 38) = 4.01, $p <. 05$.

Table 1. Descriptive statistics for scores on pretest, posttest, and transfer tasks.

Composite Score	Cognitive N=20		Metacognitive N=20		Combination N=22		Control N=19	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Pretest Conceptual Knowledge	9.00	3.76	9.90	5.41	8.59	3.76	12.63	9.22
Posttest Conceptual Knowledge	18.5	6.28	14.60	7.24	16.68	8.14	17.16	7.14
Pretest Case Interpretation	5.75	3.09	5.30	3.48	5.27	3.64	7.68	4.85
Posttest Case Interpretation	6.85	4.34	9.60	5.98	10.45	6.46	6.84	4.56
Pretest Case Redesign	7.85	4.06	10.40	6.05	8.91	3.95	11.06	4.80
Posttest Case Redesign	5.35	4.80	6.55	5.38	8.64	4.74	7.42	5.60
Transfer Case Analysis	26.95	10.30	36.40	18.11	35.64	17.41	22.42	11.51
Transfer Case 1 Redesign	12.40	6.48	13.00	6.99	10.36	6.58	11.05	7.17
Transfer Case 2 Redesign	10.10	6.44	9.50	4.99	7.73	3.78	7.47	4.51

Results of the analysis of variance for the transfer task revealed a significant difference among groups, F (3, 77) =4.18, p = .01, on case-interpretation. Planned contrasts revealed that the treatment groups outperformed the control group, t (77) = 2.71, p = .01 on case-interpretation scores. As well, the metacognitive-questions group outperformed the cognitive-questions group, t (77) = 2.01, p = .05 on case-interpretation. There were no statistical differences among groups on the case-redesign task.

Discussion

The salient finding of this study was that scaffolding questions: cognitive, metacognitive or a combination, facilitated preservice teachers as they made interpretations from contrasting video cases as opposed to affective questions, in both similar and novel classroom contexts. This positive effect was obtained in spite of the short duration of the intervention and emphasizes its value in facilitating critical observation and meaning-making, in the complicated activity of contrasting video case analysis.

The primary purpose of this study was to tease out and test the effects of specific scaffolding questions on learning. The results showed the differential impact of cognitive and metacognitive questions on different measures of understanding. Metacognitive questions facilitated participants' case-interpretation ability in both posttest and transfer tasks, i.e., similar and novel contexts. As noted by van Es and Sherin (2002), analyzing a video case involves not only identifying relevant events and contextual knowledge but also involves connecting those specific interactions with abstract conceptual principles of learning and teaching. Therefore, one would expect that questions that prompted participants to not only compare the contextual events of the two cases but also consider and connect relevant conceptual knowledge with the events in the video cases would be most effective in eliciting meaningful, principled-interpretations from the cases. Cognitive questions, on the other hand, facilitated participants' development of declarative knowledge as compared to metacognitive questions. It is possible that the cues regarding context as well conceptual information embedded in the cognitive questions facilitated the understanding of basic facts about formative assessment that was the focus of the declarative knowledge measures. Even though the cognitive-questions group scored lower than the metacognitive- and combination-questions group on case-interpretation tasks, they contributed to overall understanding by positively impacting declarative knowledge.

The within-group analysis revealed a significant improvement in declarative knowledge and case-interpretation skills. However, there was a significant decline in case-redesign scores for all groups from pretest to posttest. While participants in the treatment groups were generally able to make accurate and relevant inferences from video cases to a great extent, they failed to apply their understanding in designing assessments. This could be attributed to several factors. Firstly, the scaffolding questions in the treatment groups were geared towards interpreting events from the contrasting video cases and not specifically on redesigning assessments. The decline in redesign scores might also be due to the sequence of the three questions in the case analysis task. The first two questions dealt with case-interpretation and the last question focused on the redesign. It is possible that participants presented all their ideas in response to the case-interpretation questions and did not feel the need to repeat redundant information in response to the case redesign question. Finally, the decline in scores could be attributed to fatigue. The redesign question was the last of 14 open-ended questions answered at Session 2, a 90-minute long session. The cognitive load and mental fatigue experienced by participants may have resulted in lower engagement and interest.

Overall, this study makes a significant and practical contribution to the field of teacher education. If video cases are to be used as effective, feasible tools for preservice teachers to learn from, it is imperative that adequate support should accompany the video case analysis process. Clearly, specific types of scaffolding questions contributed to preservice teachers' learning of formative assessment in terms of declarative knowledge and case-interpretation ability. Although the instructional intervention did not significantly influence the redesign ability among preservice teachers, significant improvements in analytic and interpretive skills are an important start. Perhaps a more time-intensive intervention with several training sessions and planning-related scaffolding questions might lead to improved application.

Conclusions

Engaging in contrasting video case analysis activities can be beneficial by providing an alternative approach to gain conceptual knowledge about relevant pedagogical content in contextualized settings. As well, they present opportunities to make meaningful interpretations from the perceptual stimuli represented in the case, when accompanied by appropriate guiding questions. The relative advantage of metacognitive questioning strategies over

cognitive questions on case interpretation skills suggests the overwhelming need to provide suitable training to teachers who might use video cases as instructional tools as well as to practitioners who are required to make interpretations in actual classrooms on a regular basis. It is also important to keep in mind that additional training and tailored support is needed to support the development of planning and redesign skills. Whether similar questioning strategies that focus on those specific aspects would yield similar results is an empirical question.

The results of this study suggest specific ideas for using contrasting video cases effectively in teacher education. Firstly, it is essential to engage teachers in "active participation" when developing an instructional activity around video cases. Passively watching video cases without a particular driving question may not facilitate learning. Providing task goals in the form of analysis questions, no matter how general they are, makes the task more generative, thereby engaging the participant teacher in critical observation and interpretive analysis. Secondly, preservice teachers need guidance along with task goals. While the guidance does not have to be so specialized that it negates active processing on part of the teacher, it should be appropriately structured so as to facilitate the case analysis process. As preservice teachers gain experience in analyzing contrasting cases with scaffolded practice, the guidance may be gradually removed. The study also showed that specific questions promoted different types of understanding. While cognitive and context-specific questions were positively related to the acquisition of declarative knowledge, metacognitive questions by themselves or in combination with cognitive questions helped preservice teachers in making meaningful interpretations and inferences from multiple classroom contexts. One would expect that metacognitive questions that are specifically written to scaffold case-redesigns would also be extremely beneficial. However, this needs to be empirically investigated in a classroom context.

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