Investigating the Impact of the Presentation of Scaffolds on Preservice Teacher Noticing and Learning from Video

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Abstract: This study investigated how the presentation of scaffolds impacts what preservice teachers are able to learn and notice from video. A mixed method approach was utilized to study the change in teacher knowledge and ability to notice content from assigned treatment videos. The sample (n=41) was drawn from three randomly distributed sections of a science methods course designed to teach preservice teachers how to plan for and carry-out project-based science lessons. Findings indicate that the impact of scaffolds is dependent on their presentation and that supports such as onscreen text and teacher commentary can be used effectively to draw attention to specific content and classroom interactions. As the use of video in teacher education has become more prevalent it is imperative that we have an empirically sound understanding of how scaffolds can be used effectively to support learning from videos. The main purpose of this research is to help provide that empirical foundation.

There is widespread agreement that inservice and preservice teacher professional development (PD) is critical for the success of standards-based reform in U.S. schools (Committee on Science and Mathematics Teacher Preparation, 2001). However, the current infrastructure for professional development is ill-equipped to serve the numbers of teachers who need support in order to employ innovative teaching methods advocated by national standards, such as inquiry-oriented or project-based learning. Video based PD is one possible solution for bringing high-quality training to ever-growing numbers of teachers. Videos can provide a common reference for collaborative discussion and an opportunity for personal reflection focused on the complexities of teaching and classroom interactions (Hewitt, Pedretti, Bencze, Dale-Vaillancourt, & Yoon, 2003). Videos are most effective at supporting teacher learning when they are accompanied by specific scaffolds including explicit prompts (Beck & Marshall, 2002) that point out, for instance, important aspects of practice, and teacher commentary (Richardson & Kile, 1999) that serves to contextualize the video and provide insight into the featured teacher's thinking. While the body of research surrounding video is quite broad, there is not extensive empirical evidence that indicates the most effective way to present scaffolds with video. This study investigates the impact of the arrangement of scaffolds on teacher learning and noticing from video.

Theoretical Framework

Videos depicting authentic images of practice provide teachers with the opportunity to develop their practitioner knowledge (Hiebert, Gallimore, & Stigler, 2002) and question their pre-existing beliefs about teaching. These types of videos also provide a situated and authentic learning experience by allowing teachers to vicariously peer into real classrooms, which is the context within which teaching ultimately takes place (Beck, King, & Marshall, 2002). Using videos that situate learning within authentic contexts makes it possible to custom tailor the learning experience by providing images of classroom practice that are most relevant to a given teacher's needs (Bransford, Brown, & Cocking, 2000). Videos also create a permanent record of classroom practice that can be reviewed and analyzed without limitation providing the opportunity for deeper analysis (Beck et al., 2002; Sherin, 2004).

Scaffolds can be used to decrease the cognitive demand required of teachers as they attempt to learn from video. Scaffolds should provide structure for complex tasks and activities to support learners as they attempt to process new information and practice new skills (Quintana et al., 2002). Pea (2004) refers to this as "channeling and focusing" the attention of the learner in order to maintain progress on an assigned task or objective. Videos can be purposefully edited so that only specific portions of a particular lesson are featured serving to narrow the learner's focus to a discreet subset of skills or knowledge and thereby minimizing the cognitive demand required for learning (Kirschner, 2002). Scaffolds should also be designed around the semantics of the discipline in order to help learners make connections between what they know and what they are trying to learn (Quintana et al., 2002). Teacher commentary can serve this purpose and help authenticate and contextualize video (Richardson & Kile, 1999) while also providing insight into the thought process teachers engage in as they make decisions in the classroom (Chaney-Cullen & Duffy, 1998). Contextual clues (Chun & Jiang, 1998) can also be used to help guide a teacher as she interacts with videos by drawing explicit attention to different content. This guided noticing (Pea, 2005) might include explicit prompts that point out, for instance, important aspects of practice to attend to and help preservice teachers learn to notice and interpret classroom interactions (Sherin, 2004). Prompts can be included in teacher learning videos in a variety of ways and comparing the impact of the availability of prompts, teacher commentary, contextual clues and other types of scaffolds will help extend the research surrounding their use by determining the most effective way to incorporate them into video.

Methods

This study took place within the context of three sections of a science methods class offered at Eastern Michigan University. Students (41) enrolled in the course learned how to plan for and carry-out project-based science lessons (Blumenfeld et al., 1991) by working with an inquiry-based science unit on simple machines. The focus of this research was on a lever investigation from that unit and a collection of videos that were produced showing a classroom enactment of the lever investigation. These videos contain a multitude of information pertaining to the content knowledge (CK), pedagogical knowledge (PK) and pedagogical content knowledge (PCK) (Shulman, 1986) teachers need in order to facilitate the investigation. Therefore, using this lesson and the accompanying videos provided an opportunity to evaluate teacher knowledge about the mechanical advantage of using a lever as well as the pedagogical knowledge required to successfully conduct the lesson and address student misconceptions that could potentially occur. More importantly, it allowed for the examination of the impact of the presentation of scaffolds on teacher learning and noticing from video.

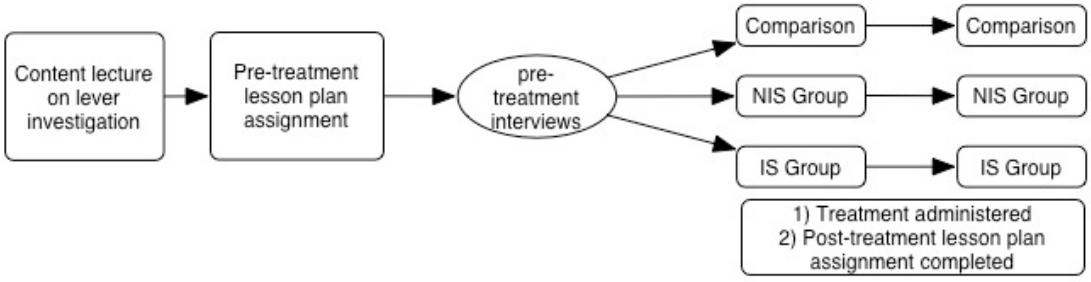

Figure 1: Study timeline.

As shown in the study timeline (Figure 1), subjects were placed into one of three conditions, the Non-Integrated Scaffolds (NIS) group, Integrated Scaffolds (IS) group and comparison group. Groups were created based on enrollment in the class after a background survey verified randomness across sections. Subjects were informed that they should approach all activities and assignments involved with this research as if they were middle school science teachers preparing to teach the lever investigation. Participants received a content lecture to review the lever investigation and then completed a lesson plan analysis assignment by responding to a variety of questions about the investigation. Questions were designed to promote thinking about potential student misconceptions and corresponding teaching strategies to address those misconceptions. This assignment established a baseline measurement of preservice teacher CK, PK and PCK in regards to the lever investigation. Pre-treatment interviews were also conducted with a sub-sample of participants to further measure teacher knowledge about the lesson and project-based instruction in general.

During the treatment, members of the NIS and IS groups viewed a set of videos designed to help prepare teachers to enact the lever investigation. The same classroom footage was used for each set of videos but the arrangement of scaffolds differed for each group. The NIS group had access to scaffolds such as static text summaries and teacher commentary (see Figure 2). This sample includes a static text prompt that participants could read before, during or after watching the specific clip. The static text prompts were characterized as available but not integrated because watching the video was not contingent upon reading the static text. In addition, even though the text prompts provided a detailed and sequential summary of the individual clips they did not identify exact locations in the video where different knowledge elements were represented. It was up to each participant watching the video to identify the specific moments within the clip where the teacher demonstrated different strategies. In the Non-IS videos Ms. Brown's commentary was incorporated so that it preceded images of actual classroom practice depicting the issues and difficulties highlighted throughout the narrative. Much like the text-based prompts, Ms. Brown's comments focused on specific teaching strategies she employed and the student misconceptions she needed to address as we see in this sample transcript of a portion of her commentary.

> "While we were reviewing the data it became obvious that the boys and girls forgot why we were doing the lever investigation. You need to revisit that question that's at the beginning of the investigation 'How does a lever help you lift a brick' otherwise the students are just rushing through and they forget the purpose of the investigation."
> (Ms. Brown's teacher commentary from Non-IS video)

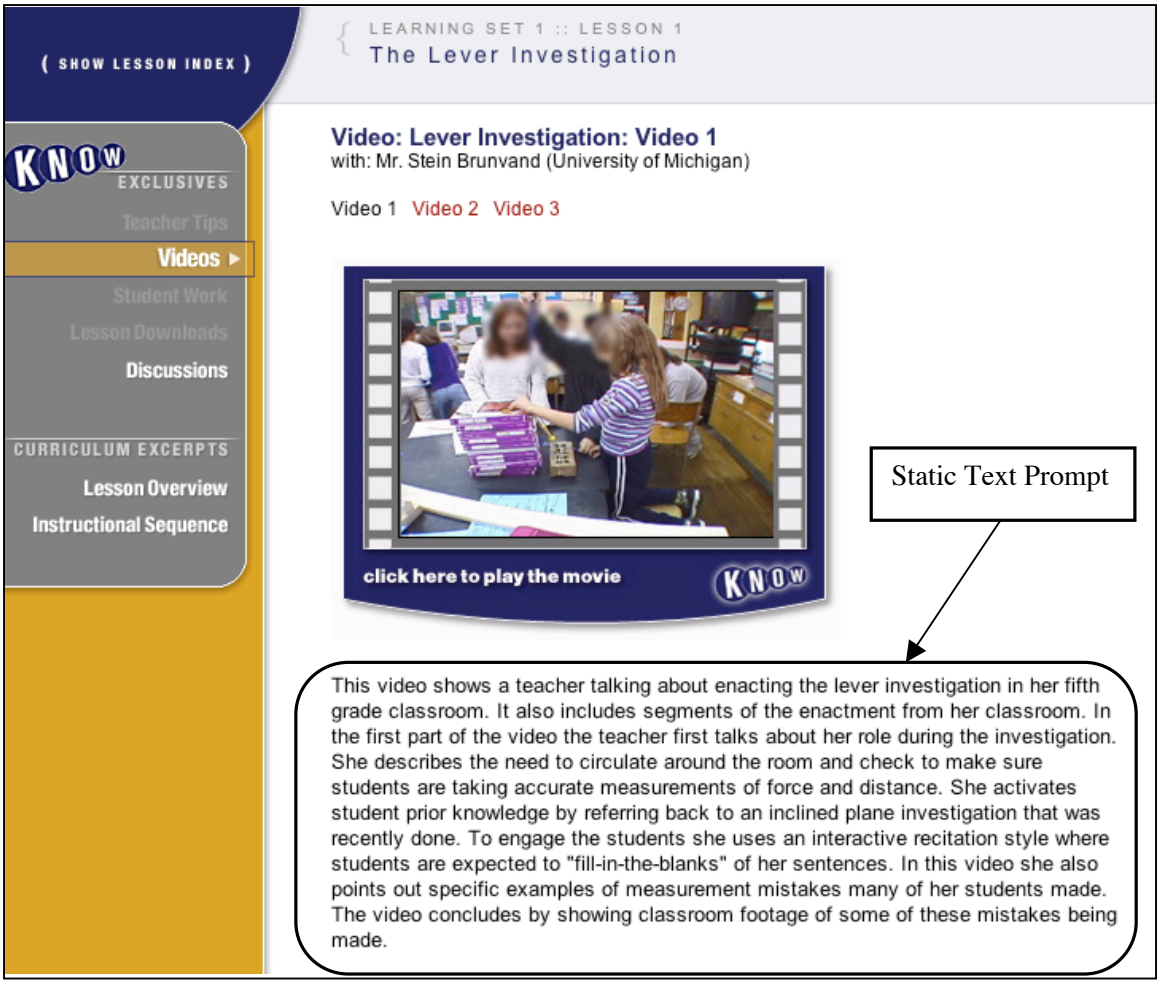

Figure 2: Screenshot showing arrangement of static text scaffold.

The Integrated Scaffolds (IS) videos (see Figure 3 for sample) were produced with scaffolds that contained the same information as those used in the Non-Integrated Scaffolds group videos but were more purposefully integrated. In addition to static text prompts, hyperlinks were incorporated with the IS videos so that users were able to click on specific statements such as "Modeling Proper Procedure" or "Identifying Common Measurement Mistakes" and be taken directly to specific parts of the video. The links were designed to cue participants to a specific piece of knowledge and provide an explicit organizational structure by promoting sequential navigation through the video. Ms. Brown's commentary was presented as a voice-over for classroom footage so that participants were able to hear her talking about various situations that occurred during the investigation while simultaneously seeing the classroom images that corresponded with her commentary. On-screen text and titles were added to help draw attention to different interactions and provide participants with vocabulary they could use to describe what was happening. These titles reinforced the information provided in the static text prompts and Ms. Brown's commentary and, more importantly, helped explicitly point out different representations of CK, PK and PCK as they occurred throughout the videos.

The Non-Integrated Scaffolds and Integrated Scaffolds videos also differed in regards to the amount of time and money required for production. The IS videos required over twice as much time to produce (24 hrs. vs. 11 hrs.) primarily because of the extra editing required to create the on-screen titles and the programming that was necessary to make the hyperlinks work properly. It's important to remember that this is for a single 50-minute lesson. When producing multiple videos for a sequence of lessons this time difference would quickly become a major issue, which is why it would be helpful to know if the additional investment of labor, and money necessary to pay for that labor, is justified by the creation of video that is significantly more effective in impacting teacher learning.

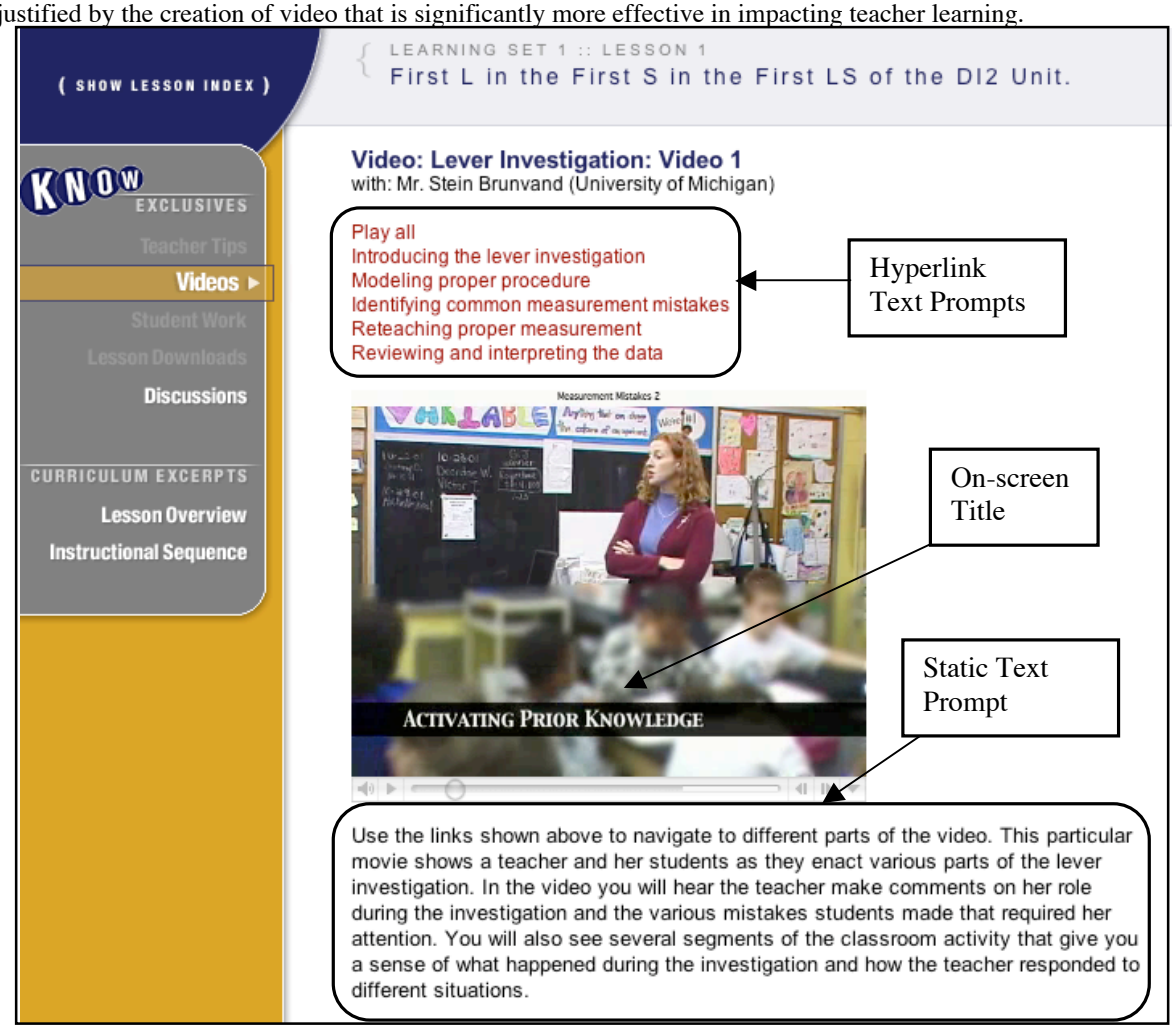

Figure 3: Screenshot showing arrangement of scaffolds in integrated scaffold video.

Unlike the two treatment groups, the comparison group did not watch any videos. Instead, they participated in the lever investigation with the course instructor in order to experience the lesson from the perspective of a middle school student. Participants then completed a second lesson plan analysis assignment to determine if there was a change in their thinking and knowledge in regards to the investigation.

Data Analysis

Pre-treatment interviews were tape recorded, transcribed and coded for knowledge of the CK, PK and PCK required for teaching the lever investigation to ascertain what misconceptions participants were able to anticipate and create a record of how they proposed to deal with those misconceptions. Transcripts were also coded for beliefs about teaching and student learning to determine if participants thinking in this area aligned with project-based science instructional components. Lesson plan analysis assignments were coded in a similar fashion to the interviews with attention paid to the CK, PK and PCK subjects noted in their individual responses. The post lesson plan assignments were coded with specific attention paid to whether participants made reference and/or elaborated on those particular misconceptions and strategies exhibited in the treatment videos.

Notes generated by subjects from the NIS and IS groups during the treatment were coded for references to particular parts of the videos, focus of notes (i.e. teaching strategies, classroom management) and references to specific scaffolds. Coding was done in conjunction with viewing the individual screen capture movies generated for each subject during the treatment. This provided the opportunity to see exactly when participants modified their notes and cross-reference that with what was occurring in the treatment video at the time the notes were modified. For instance, some participants included direct quotes from the onscreen text or teaching commentary scaffolds in their notes. These references were tabulated and analyzed to determine what, if any, themes existed pertaining to areas of interest and attention related to the videos and the frequency with which participants referred to the various scaffolds.

Codings were compared through a series of repeated measures analysis of variance tests, which allowed for the investigation of the change in score on pre and post-treatment assignments within groups. In the event that the repeated measures analysis revealed the presence of interactions further analysis was conducted dependent on what variables were involved. When significance was detected involving a categorical variable a Fisher's Exact test (Simple Interactive Statistical Analysis, 2005) was computed. When significance was found between groups on a continuous variable, like the frequency of using a particular scaffold, a oneway ANOVA test was run. Oneway ANOVA tests were also used to test the variance of the means for several other continuous variables associated with the three primary measurement instruments.

Results

Pre and post-treatment lesson plan analysis assignments were coded for mention of pre-identified student misconceptions. Throughout the lesson the enacting teacher, Ms. Brown, employed a variety of teaching strategies and responses were coded for mention of these strategies as well. A series of crosstabulations revealed that the comparison group was significantly more likely (p =.031) to mention the teaching strategy of activating prior knowledge in the pre-treatment assignment. Findings for the remaining teaching strategies and both student misconceptions were equally likely to be mentioned by all three groups. However, responses from the post-treatment lesson plan analysis assignment revealed many significant differences between groups. The Integrated Scaffolds group was significantly more likely to mention both the measuring and mechanical advantage misconception than the comparison group. In addition, Non-IS group members were more likely to mention the teaching strategies of modeling measurement, reteaching and modeling the interpretation of results. Similarly, members of the Integrated Scaffolds group were significantly more likely then the comparison group to mention both misconceptions along with the teaching strategies of modeling proper measurement, reteaching for understanding and activating prior knowledge.

Many participants noted that students might have trouble graphing their results from the lever investigation. This is a valid misconception but not one that is portrayed or addressed in the treatment videos so it was coded as an "additional" misconception. Groups didn't differ significantly on the number of additional strategies or misconceptions they mentioned in the pre-treatment lesson plan analysis assignment. However, post-treatment

assignment responses revealed a significant difference (p =.000) for additional misconceptions mentioned. To determine the exact nature of this significance Mann-Whitney tests were calculated to make pairwise comparisons between groups. These calculations indicated that members of the Integrated Scaffolds group were significantly less likely to mention additional misconceptions in their post-treatment lesson plan analysis assignments than both the Non-IS and comparison group. A repeated measures analysis test revealed that this was a significant change from pre to post-treatment for the IS group. This change is illustrated in Figure 4, which includes the Non-Integrated Scaffolds and comparison groups' change in additional misconceptions stated for comparison purposes. One possible explanation for this finding is that they were so focused on the two misconceptions highlighted in the treatment videos that they were unable to anticipate other potential problems.

A series of repeated measures analysis tests were conducted for each condition to investigate the change in responses from pre to post-treatment lesson plan analysis assignment. These tests, illustrated in Figure 5, revealed that the Integrated Scaffolds group's frequency of mentioning the distance measuring and mechanical advantage misconceptions changed significantly from pre to post-treatment assignment. The Non-Integrated Scaffolds group was only significant in its change in mentioning the distance measuring misconception and the comparison group did not show significant change on either misconception.

As shown, the IS group was the only group where 100% of the participants mentioned both the mechanical advantage and measuring distance misconception. A similar trend was found when looking at the change over time in regards to the frequency of mentioning the targeted teaching strategies highlighted in the treatment videos. The IS group showed significant change for six of the strategies including interactive recitation, explicitly interpreting investigation results, modeling proper measurement, presenting results as combined class data, reteaching and activating prior knowledge. The Non-IS and comparison group showed a significant change on only one teaching strategy and that was presenting results as combined class data.

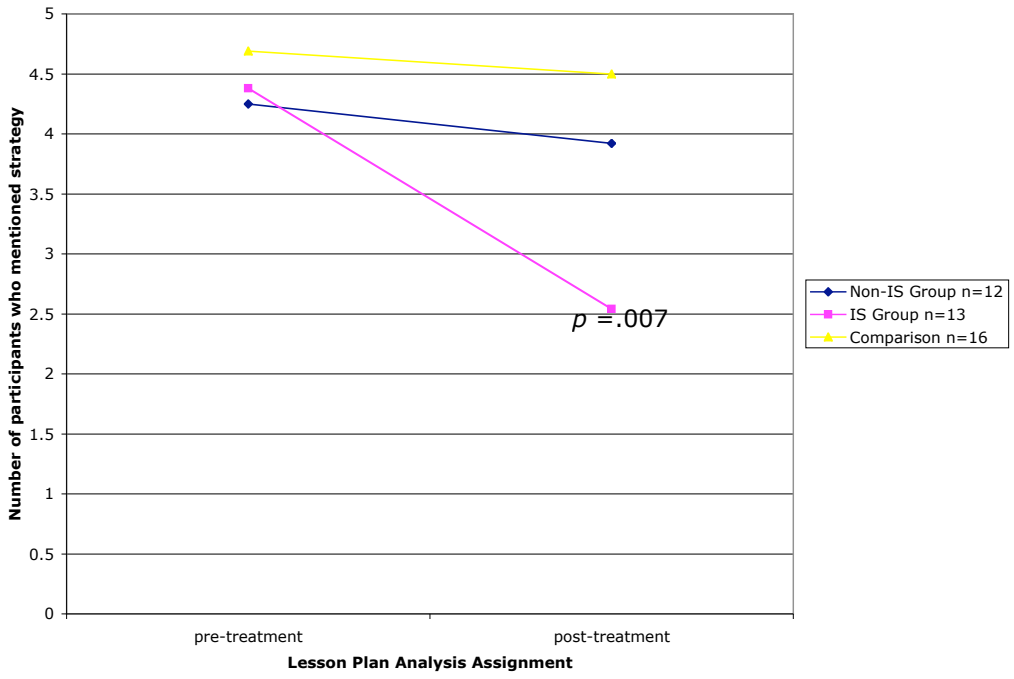

Figure 4: Change by group in mean number of additional misconceptions mentioned from pre to post-treatment lesson plan analysis assignment.

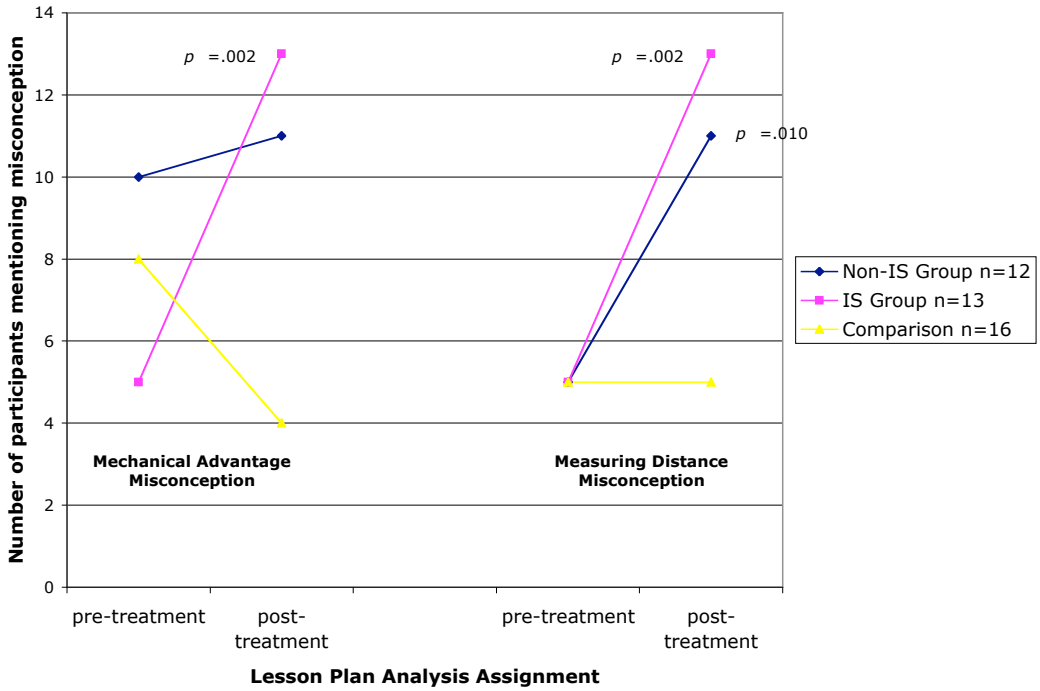

Figure 5: Change by group in mentioning of identified misconceptions between pre and post-treatment lesson plan analysis assignments.

What is interesting about these findings is that the IS group appeared to be significantly impacted by the availability of scaffolds in their videos as evidenced by the fact that they showed a significant increase in their frequency to mention more than half of the identified strategies. It's important to note that participants did not have access to their treatment notes while completing the post-treatment lesson plan analysis assignment so the above findings can't simply be attributed to the fact that IS group members copied more strategies from their notes into their assignment responses.

Watching the individual screen capture movies revealed that several of the preservice teachers wrote direct quotes from Ms. Brown's teacher commentary or closely paraphrased what she said in their notes. Another common occurrence within the IS group was copying, in many cases verbatim, the onscreen text prompts into their notes. This phenomenon was not observed within the Non-Integrated Scaffolds group as their videos did not include the onscreen prompts. To see how these scaffolds impacted preservice teachers' noticing of specific content, treatment notes were coded for the frequency that a subject copied, paraphrased or quoted the narrative commentary, onscreen titles or static text summary. A series of Mann-Whitney tests were run to determine if groups differed significantly in the frequency with which they quoted or paraphrased scaffolds to specifically mention misconceptions or strategies in their notes. Table 1 below shows that members of the IS group were significantly more likely to mention six of the identified teaching strategies as a result of quoting or referencing a scaffold. Findings for the remaining teaching strategies and both student misconceptions were not significantly different in this regard.

From these results it appears that members of the IS group were influenced more significantly by the scaffolds in what they chose to record in their notes at least as it relates to these specific strategies. That's not to say that preservice teachers in the Non-IS group didn't mention these strategies but it does indicate that the note-taking behavior and decisions of the IS group was at least partially impacted by the scaffolds.

Table 1: Mann-Whitney tests of frequency teaching strategies were mentioned in treatment notes as a result of a scaffold.

Teaching Strategy	Group (n=25)	Mean	Range	*p*
Reviewing Investigation Procedures	Non-IS (n=12)	.000	0-0	.003
	IS (n=13)	.500	0-1	
Activating Prior Knowledge	Non-IS (n=12)	.000	0-0	.018
	IS (n=13)	.583	0-2	
Circulating through Room/Checking Progress	Non-IS (n=12)	.083	0-1	.052
	IS (n=13)	.583	0-2	
Rephrasing Questions	Non-IS (n=12)	.000	0-0	.010
	IS (n=13)	.417	0-1	

Educational Implications

The results of this investigation indicate that when scaffolds such as onscreen text prompts and teacher commentary are explicitly integrated into video they can have a significant impact on what preservice teachers notice and learn from video. When scaffolds are presented in this integrated fashion they can also influence how participants view videos and make decisions about what notes to record. In addition, this study revealed some emerging findings that warrant further investigation. These include the fact that onscreen text prompts can be an effective way to provide teachers with the vocabulary they need to describe different pedagogical strategies and interactions that occur in the classroom. These prompts can cue teachers to pre-identified content and help draw attention to specific examples of practice. By using these prompts the cognitive load of the teacher is reduced as she can rely on the onscreen text to pinpoint specific interactions as opposed to having to depend on her own skills of observation to identify salient interactions. This is particularly helpful when trying to make connections between pedagogical theory and concrete representations of that theory in an authentic classroom.

Another emerging finding was that the content and presentation of scaffolds should align closely with the learning objectives and goals of the video. Through this alignment teachers are more likely to recognize salient interactions and complete the tasks they are given associated with the video. In the present study preservice teachers were asked to identify as many student misconceptions and teaching strategies as they could. Scaffolds were designed to specifically draw attention to these interactions and therefore in close alignment with the task participants had been assigned.

Finally, decisions about what content and interactions to highlight through scaffolds should be made with the understanding that when you chose to direct attention towards some aspect of the classroom you are simultaneously directing attention away from other aspects. In many cases that is exactly the goal of using scaffolds but it can also result in teachers' focus becoming so narrow that they are unable to see beyond what the scaffolds are highlighting. This finding emphasizes the need to show a particular lesson from multiple perspectives and classrooms so that preservice teachers have a better chance of seeing a wide-range of problems and solutions arising from the same basic lesson.

Conclusion

Video is an effective way to provide teachers with an authentic view of specific classroom interactions to observe so that they can develop their professional knowledge and witness firsthand the application of pedagogical theory in a practical setting. Scaffolds can be used to support teachers in their learning from video by drawing attention to pre-determined content and events. The purpose of this research was to add to the existing body of research surrounding video and the use of scaffolds by determining what impact the presentation of scaffolds had on preservice teachers' learning and noticing from video.

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