The influence of video analysis on the process of teacher change

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ABSTRACT

If the purpose of reflection is to improve teaching, it is essential to understand how video-aided reflection influences teacher change. Yet, there is limited research addressing how video analysis influences the change process. The purpose of this study was to gain an in depth understanding of how video influences the process of teacher change. Teachers in three different teaching environments engaged in semester-long video-reflection groups. Through a descriptive analysis of these meetings, participants' own video-analyses, and individual interviews, six over-arching themes emerged across the different environments that describe the change process. Teachers reported that video encouraged change because it helped them: (a) focus their analysis, (b) see their teaching from a new perspective, (c) trust the feedback they received, (d) feel accountable to change their practice, (e) remember to implement changes, and (f) see their progress. We discuss how these results may help researchers and educators understand how video can be used to encourage teacher improvement.

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1. Introduction

Since Schön (1983) published "The Reflective Practitioner," reflection has been an integral part of most teacher training programs. Several national teacher accreditation agencies throughout the world, such as the National Council for Accreditation of Teacher Education (USA), the Department for International Development (UK), and the Teacher Registration Board (Australia) include reflective practice as a key component to improving teacher quality, regardless of differences in approach (e.g., certifying teacher programs vs. certifying individual teachers). Despite the preponderance of reflective practices in assuring teacher quality, research on reflective practices has not generated a solid base for understanding the effect that reflective practices have had on teaching. There is a need to explore not merely the content of reflection, but the effect reflection has on how teachers alter their practices (Korthagen & Wubbels, 2001). The purpose of this study was to examine how video analysis influenced the process that led teachers to reflect on and subsequently change their teaching.

1.1. Video analysis review

In a review of the use of video for teacher training worldwide, Brouwer (2011) identified three domains of application: orientation, support, and assessment. One of the earliest methods of using video to improve teacher learning was through microteaching, wherein a teacher is recorded teaching a short lesson to his/her peers. S/he then reviews this lesson for proficiencies and deficiencies and reteaches the lesson. In a review of the use of video for teacher preparation in the past 25 years, Tochon (2008) noted that microteaching is now practiced throughout the UK, Europe, North America, Asia, and Oceania, solidifying the use of video as a valid method for teacher improvement. Over time, however, the practice has changed from one focused on identifying specific, isolated, behaviors, to one more appropriately termed video-reflection, wherein teachers video videos of themselves or others to critically think about the effects of particular actions within a situated environment.

Technological advances are pushing the use of video even further. Increasingly, institutions across the world are developing video analysis tools that make the process of viewing, analyzing, and sharing videos easier for instructors (Rich & Hannafin, 2009). Video analysis tools are emerging as an increasingly viable and accessible tool to facilitate teacher reflection. Consequently, there has been an increase in research studies focused on the benefits of using video to reflect on teaching (Maclean & White, 2007). These

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studies have consistently reported that video is beneficial for helping instructors reflect on their teaching. Reported benefits typically fall under two general categories: improved ability to evaluate teaching and changes made to teaching.

1.1.1. Improved ability to evaluate teaching

Video has enabled teacher administrators to recognize important patterns in teachers' practice. Probably the most well-known of such studies is the Trends in International Mathematics and Science Study (TIMMS) that included video of teachers from seven different countries and 1000 different classrooms (Hiebert et al., 2003). Countries not included in the TIMMS video have also used video to this same end. In both Mexico and Chile, such studies have enabled important changes to take place in the way teachers are prepared for classroom practice (Loera, 2006; Manzi, Preiss, Flotts, González, & Sun, 2008). These videos are made publicly available for teachers and administrators alike to evaluate teaching.

On a more individual, formative, level, several studies reported that using video to reflect helped teachers to identify gaps between their beliefs about good teaching and their actual teaching practices (Rich & Hannafin, 2008; Bryan & Recesso, 2006; Grainger, 2004; Griswold, 2004; Miyata, 2002; Pailliotet, 1995). Donnay and Charlier (1990) initially positioned video self-reflection as an act of confronting one's image of teaching with one's actual teaching. A recent example of this is when Bryan and Recesso (2006) asked science education student teachers to write a belief statement about what they considered to be good teaching. Throughout the semester, teachers videoed themselves and used the Video Analysis Tool (VAT) to identify contradictions or confirmations of their teacher belief statement. Researchers reported that, "prospective teachers became cognizant of tensions in their teaching" (p. 36), pointing to specific examples of when preservice teachers' actual teaching conflicted with their conception of ideal teaching.

Video analysis has also helped teachers articulate their tacit assumptions and purposes regarding teaching and learning (Meade & Meriman, 1992; Powell, 2005). Powell asked teachers to review a video of their teaching and mark three segments to share with the researcher. Powell reported that video analysis helped teachers articulate their feelings about their teaching and make their tacit assumptions about learning explicit. The teacher in Meade and Meriman's study also became better at articulating his purposes for making specific instructional decisions as he used video to review his teaching.

Other studies reported video allowed teachers to notice certain aspect of their teaching which they did not remember (Rich, Recesso, Allexsaht-Snider, & Hannafin, 2007; Dye, 2006; Griswold, 2004; Pailliotet, 1995). Teachers often commented, "I never saw that before" (Pailliotet, p. 155). Studies reported that video analysis was beneficial because it allowed teachers to compare their teaching videos to what they remembered about their lesson.

Halter (2006) and Sherin and van Es (2005) noticed that the focus of teachers' reflections changed when they used video analysis. The teachers in Halter completed a reflection guide as they viewed their videos. The focus of the teachers' reflections shifted from a focus on pedagogy to both pedagogy and classroom interactions. Tochon (2008) referred to this shift as one from using video to reconstruct past actions to instead use video to collaboratively reflect on prior teaching and plan for future changes.

Several studies also reported that video helped instructors assess the strengths and weaknesses of their teaching (Rich, et al., 2007; Tripp, 2009; Schmidt & McCutcheon, 1994; Struyk & McCoy, 1993; Wu & Kao, 2008). For example, teachers in Struyk and McCoy watched a video of their teaching and coded the number of times certain behaviors occurred. Teachers were able to use the

information they gained from the evaluation to prioritize problem areas in their teaching. Teachers also reported that video was beneficial because it allowed teachers to evaluate themselves as many times as they wanted, and teachers did not need a supervisor or colleague present to receive feedback on their teaching (Tripp, 2009; Brouwer, 2011). In contrast, through the use of video peer assessment, preservice teachers in Taiwan were able to engage in valuable dialog that resulted in significant teaching changes (Wu & Kao, 2008).

Most studies reported that using video to reflect was beneficial for helping teachers to evaluate their teaching. After using video to reflect, teachers were able to: (a) identify gaps between their beliefs about good teaching and their actual teaching practices, (b) articulate their tacit assumptions and purposes about teaching and learning, (c) notice things about their teaching that they did not remember, (d) focus their reflections on multiple aspects of classroom teaching, and (e) assess the strengths and weaknesses of their teaching.

1.1.2. Changes made to teaching

Previous studies also reported that teachers increased effective teaching behaviors as a result of video reflections. Teachers in Hougham (1992) viewed videos of their teaching and evaluated their question-asking strategies using an observation form. Teachers who used video evaluations improved their question-asking strategies to a greater degree than teachers who did not receive video evaluations. Sherin and van Es (2005) reported that teachers who participated in video clubs changed their questioning strategies and provided more time for students to share and comment on each other's work. Brawdy and Byra (1994) noticed that preservice teachers increased the frequency of their positive specific statements and modified the frequency of their positive general statements they provided to the learners. Additionally, Rich, et al. (2007) felt that video analysis helped teachers develop a course of action for future teaching situations. Although previous studies reported that teachers increased effective teaching behaviors as a result of participating in video reflections, studies did not describe how video influenced the process that led teachers to change their teaching.

1.1.3. Unaddressed issues and future research

Most studies that have examined the impact of using video analysis to reflect on teaching reported that video analysis was beneficial for helping teachers evaluate their teaching. Yet, few studies actually described how video impacted the teacher change process. Schön (1983) stated that reflection involves more than understanding the teaching situation; reflection should also lead the teacher to action. Teachers must "determine the directions in which they will try to change" (Schön, 1983, p. 165). The ability to reflect critically for future action becomes increasingly important in light of recent research that suggests there is a positive correlation between a teacher's pedagogical content knowledge and their ability to analyze a recording of a video lesson (Kuntze & Reiss, 2005). Many prominent reflection theories also claim that reflection should involve change and an evaluation of the change (Taggart & Wilson, 1998). Currently, we do not know very much about how video analysis influences the process of teacher change. The primary focus of this study was to examine how video reflection affects the process that led teachers to change their teaching.

2. Material and methods

A multiple case-study approach was used for this study. Stake (1995) described case studies as "the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances" (p. xi). A multiple case study
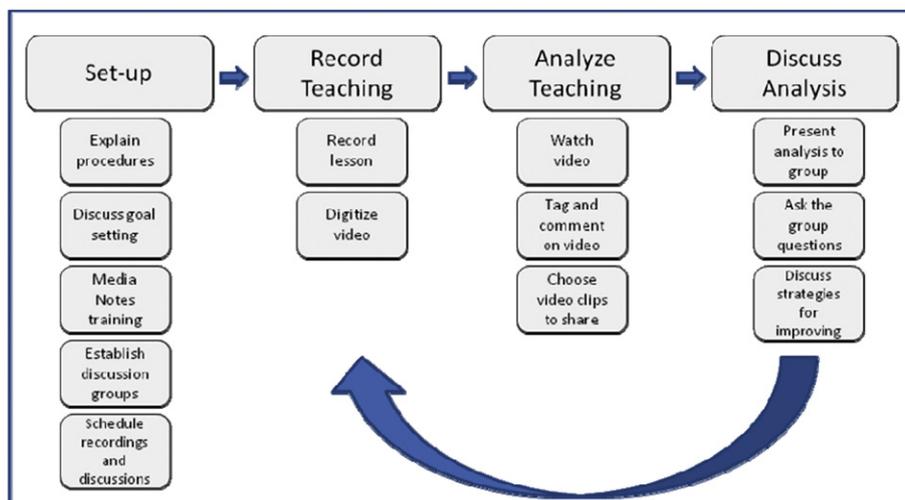
Fig. 1. Procedures for participants during the study.

approach allowed the researcher to focus on understanding the depth needed to understand underlying psychological and perceptual processes that purportedly described the teachers' change process. In all, seven cases of teachers engaging in video reflection practices were used.

2.1. Participants

Teachers were chosen from several instructional settings in order to identify common patterns across a variety of teaching contexts. There were seven participants in all: Three Special Ed teachers, two Religious Ed teachers, and two English Language Learner (ELL) teachers. The teachers were Caucasian females between 23 and 35 years of age. Their teaching experience ranged from one to eight and a half years, and their students ranged in age from 3 to 18 years. All of the teachers volunteered to participate in the video analysis process.

2.1.1. Special education teachers

Rachel,[1] Jen, and Amy taught at a private school for autistic children. Rachel had been teaching special education students for eight years, and this was her second year teaching at the school. This was both Jen and Amy's first year teaching at the school. Previously, Amy was a volunteer at the school, and Jen taught fourth grade in a public school. Students at the school were divided by their developmental level. Rachel taught students functioning at the highest autistic level. Amy taught students functioning at the middle level, and Jen taught the lowest functioning students. Rachel learned about video analysis from a friend that was teaching at the university and asked if she could use the tool to help her evaluate her teaching. After being informed about this study, Rachel and her colleagues volunteered to participate. All three teachers chose to meet together to discuss their analyses. During their meetings, the instructors sat on the floor in the hallway and took turns watching and discussing the analyses.

2.1.2. Religious education teachers

Erin and Kathryn were employed by the Church of Jesus Christ of Latter day Saints to teach religious education classes to high school students during regular school hours. At the time, they were teaching New Testament to four classes each day. Kathryn had been

teaching for almost nine years, and Erin had been teaching for ten years. After a casual conversation about the video analysis tool, MediaNotes, Erin and Kathryn asked if they could use it to analyze their teaching. Erin and Kathryn were a little nervous to view themselves on video, but expressed excitement to try out a new technology. Erin and Kathryn also chose to discuss their analyses together. During their discussions, they sat on a couch with their laptops and viewed each other's analysis.

2.1.3. English Language Learner (ELL) teachers

Melissa and Betsy taught at an English Language Center (ELC), and this was their first time teaching ELL students. The ELC is and independent affiliate of a large private university where the researchers both work. Annually, there are roughly 650 students representing 20 different native languages, ranging from novice-low to advanced-low language speakers. Melissa had experience teaching in small group settings, but was a little nervous about how her teaching experience would transfer to a new situation. In addition to teaching at the ELC, Betsy taught English to Japanese students online. This was her first time teaching in a face to face environment. Betsy was nervous about teaching and thought video analysis would help her improve. Melissa and Betsy heard about this study from their supervisor and chose to be participants. Melissa and Betsy chose to discuss their videos with their supervisors. They brought their analyses to their regular meetings with their supervisor. Betsy also discussed her videos with a colleague.

2.2. Procedures

This study took place over two months. Fig. 1 shows the steps that participants followed. We describe these steps in detail in the following narrative.

2.2.1. Set up

The first week of the study was spent setting up the process. The researcher met with each group of teachers to explain the procedures and to discuss their goals for improving their teaching. Each teacher defined criteria for what they believed constituted good teaching. Then they selected two to three criteria they wanted to focus on for their analyses. MediaNotes was downloaded to the teachers' computers, and they were trained to use the tool.

MediaNotes® is a commercially available video analysis tool that allows users to upload, tag, and annotate segments of the video (see Fig. 2). MediaNotes was chosen over other video analysis tools
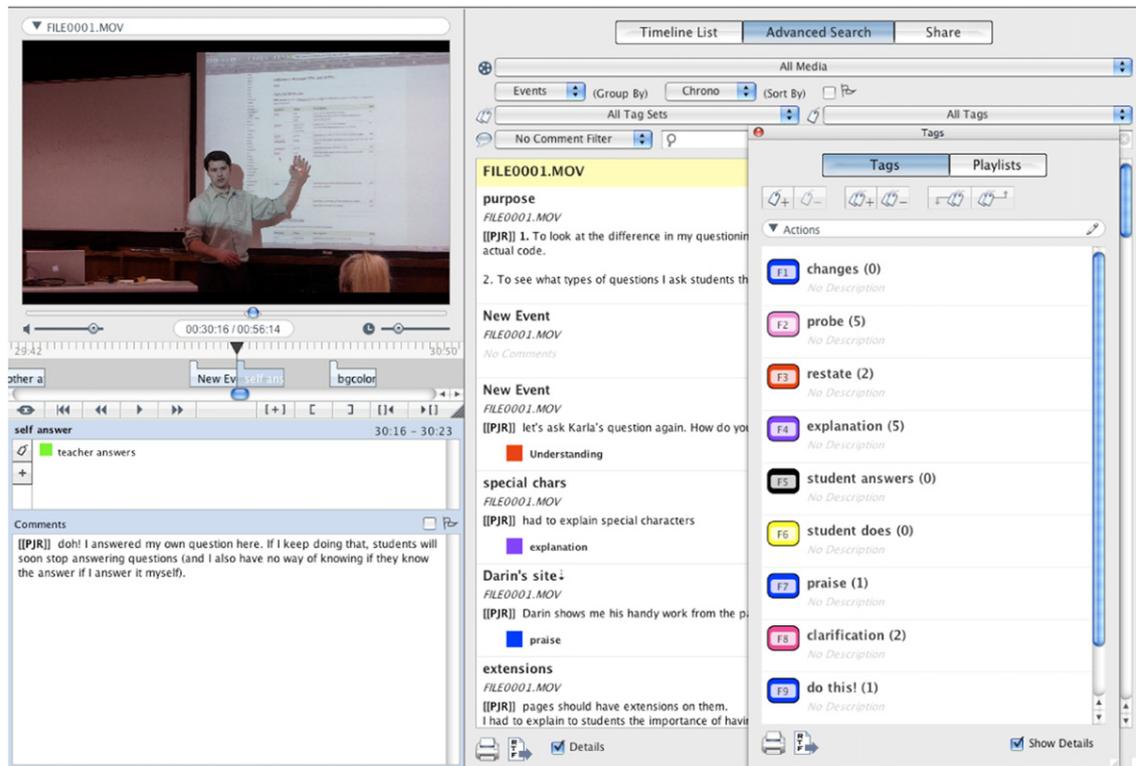
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[1] All names are pseudonyms.

Fig. 2. Screenshot of a teacher's self-analysis in MediaNotes.

because the coding and search options make it easier to data mine (Rich & Hannafin, 2009; Tripp, 2009). Additionally, it is free to our university students and faculty who are conducting research with teachers because it was originally developed at the researchers' institution.

After teachers became familiar with MediaNotes, they selected peer(s) or supervisor(s) to meet with them to discuss their video analyses. Finally, the teachers set a flexible, regular schedule (e.g., every other Monday) for recording their teaching and discussing their analyses.

2.2.2. Record teaching

During the following weeks, the teachers continued to work on their teaching goals. Teachers recorded a lesson with digital cameras provided by the researcher by setting up an unmanned camera in the back of the room, using a surveillance-type method for video recording (Fadde & Rich, 2010). Teachers were allowed to record any lesson they felt would be beneficial to analyze, but were directed to record a lesson that would enable them to reflect on and analyze teaching activity related to their chosen focus. After recording the lesson, the teachers downloaded the video from the camera and uploaded it into MediaNotes® on their own computers.

2.2.3. Analyze teaching

Teachers used MediaNotes to analyze their video. The teachers chose three to four codes to use during their analysis. These codes were based on the goals they set for improving their teaching. Some examples included checking for understanding, pacing, active participation, student cues, etc. To conduct their analysis, they used MediaNotes' tagging features to mark specific segments according to their own frameworks and the commenting features to provide detailed insight on video clips that provided evidence of when they met or did not meet their goals. A reflection guide was provided to the teachers. This guide encouraged teachers to reflect on their

teaching from either a technical, interpretive, or critical stance (Powell, 2005). Teachers then chose specific clips to share with their discussion group.

2.2.4. Discuss analysis

Discussions were usually held in a casual setting in the teacher's workplace. The teachers often sat on the floor or a couch next to each other and shared their video clips from their laptops. During the discussions, teachers gave a brief explanation of the background of their lesson and introduced the video clips they planned to show. Teachers often presented a question about their teaching and then showed a few video clips that highlighted the question. The group discussed the clips with the teacher and offered suggestions for future teaching situations. A discussion guide was provided to facilitate conversation. This guide encouraged teachers to: (a) provide background about the lesson being taught (1 min), (b) present their findings, exemplified through a few key responses (2 min), (c) ask peers to write a brief response to what they saw (5 min), and (d) engage in group feedback by sharing each others' thoughts (7–10 min). However, groups usually skipped the written feedback and instead went from sharing a few key clips to engage in group discussion. After group feedback, teachers refined their goals, set a new goal, or continued working on the same goal. The researcher tried to remain a non-participant observer (Patton, 2002) during the discussions. However, the teachers often asked questions and shared their experiences with the researcher before and after their discussions.

2.3. Data collection

2.3.1. Observations

The researcher observed the teachers' video discussions with their peers or supervisor. During this time, the researcher was a non-participant observer (Spradley, 1980) who made observational

notes during the video meetings. During the observations, the researcher sought to understand how teachers were using the video analysis tool to change their teaching practices. The conversations during the observations were recorded and transcribed. Written notes were also used to answer the observation questions. The researcher asked participants follow-up questions after each observation in order to clarify additional questions that arose.

2.3.2. Interviews

The researcher conducted semi-structured interviews with participants after they had repeated the video analysis process four times. The interviews lasted between 20 and 45 min. The purpose of the interview questions was to understand how the use of the video analysis tool influenced the process that led teachers to change their teaching. The interview questions were flexible to allow the participants to discuss additional points of interest. Examples of the questions are: What changes did you decide to implement in future teaching situations? Describe the process you followed to notice needed changes. How did video analysis influence the changes you decided to make to your teaching, if at all? Etc.

2.3.3. Artifacts

The researcher reviewed the video analysis clips and written comments in order to understand how teachers used video analysis to change their teaching. Video clips were also reviewed to look at how the instructors implemented the changes they decided to make to their teaching.

2.4. Data analysis

We used domain and taxonomic analysis, as recommended by Spradley (1980) for analyzing case studies. The data were reviewed to look for common themes that appeared (cover terms and domains). Then NVIVO, a computer-assisted qualitative data analysis software, was used to code the data according to the domains that were identified. The data were re-coded to identify sub-themes for each of the domains. The researcher reviewed the data to identify issues that were consistently raised by participants or appeared to be very important to a participant. The researcher then conducted a taxonomic analysis by identifying sub-domains within each theme. During the analysis process, the researcher looked for negative cases that contradicted the sub domains. When negative cases were identified, the researcher adjusted the themes by either merging or forming new categories so as to include distinctly different data (in terms of content). After a final list of domains and sub domains was created, the data were re-coded a final time through a cross-comparison of the quotes included in each category. The resulting taxonomic structure is represented in Fig. 3.

3. Results

The ensuing discussion outlines four major themes we identified as teachers met in groups to regularly discuss their individual video analyses of their teaching, as it relates to the perceived changes that occurred in their own teaching. Henceforth, when we refer to "teachers," we are referring to all of those participating in each group. This includes teachers, their peers (who were also analyzing their own videos), as well as their supervisors (who participated in the group video analysis, but did not review video individual outside of this review).

As teachers used video analysis to reflect on their teaching, they reported a change process consisting of the following steps: (a) recognizing the need to change, (b) brainstorming ideas for change, (c) implementing the ideas, and (d) evaluating changes that were implemented. Teachers said that video analysis was beneficial at
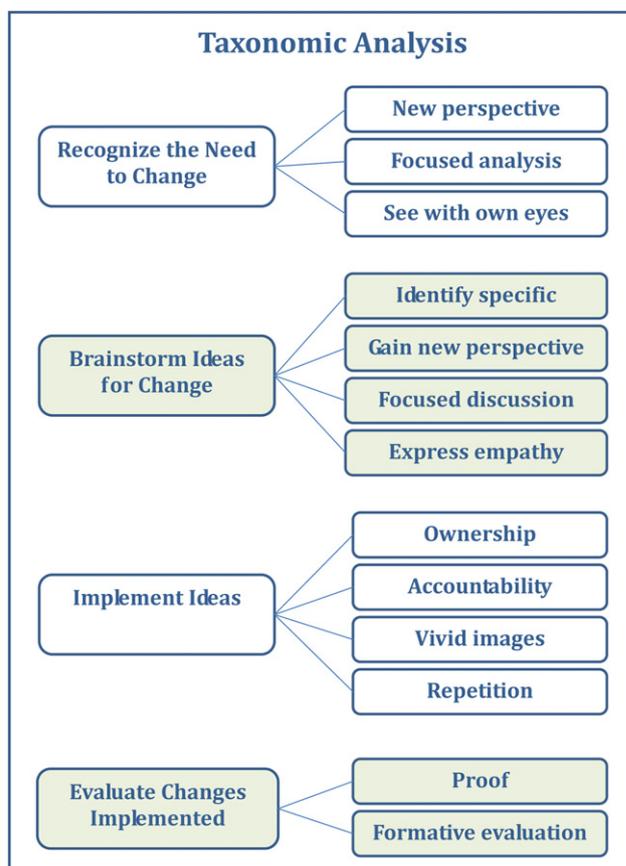

Fig. 3. Taxonomic analysis of the change process.

each of these stages (see Table 1) and that they were more likely to change their teaching practices when they used video analysis to reflect than previous feedback methods they had used to improve their teaching (e.g., personal reflections, classroom observations, workshops, etc.). The following sections discuss how video analysis influenced each of the four steps in the change process. Each section begins with a brief summary. Then a table of common themes that emerged from the data is presented, followed by evidence to support each of the themes.

3.1. Recognize the need to change

The first step in the change process was for teachers to recognize the need to change. Teachers felt that it was beneficial to analyze their video in MediaNotes because the tool allowed them to watch their video multiple times, gain a new perspective on their teaching, and focus their reflection. After using MediaNotes, teachers commented that they were more likely to change their practices than after participating in other feedback methods because video allowed them to literally "see" the need to change with their own eyes. Table 2 identifies the factors that seemed to affect teachers' abilities to recognize the need to change and benefits that were mentioned about each of the factors.

3.1.1. Gain new perspective

Teachers reported that reflecting via video analysis was easier than trying to reflect in action because they were able to see themselves from a new perspective. Reflecting in action is often difficult for teachers because there are many things that compete for their attention while they are teaching. Jen explained, "When you're in the moment, you don't realize what's happening, but

Table 1
Reported benefits of video throughout the change Process. Teachers' reported changes.

Group	Participant	Recognize need	Brainstorming	Implementing ideas	Evaluating
Religious Education	Erin	If you have the video, you can watch yourself again and see oh, I didn't realize I do that.	Video is so much easier than trying to explain it all and then ask for suggestions.	As I'm teaching, and I'm standing by my podium, I'll see the video in my head, and I'll move because the scene comes to my mind of just standing there and thinking I need to be moving.	Video gave me more concrete examples to whether I had done good or bad so it was more than just a feeling
	Kathryn	The video analysis helps me be more…recognize reality.	I think getting other people's input helps the most because you can only see yourself so much and then after awhile you're like I'm doing great. But then someone will give you a little more to make it that much better	Specifically because of watching something that Erica did and a recommendation she made when she watched mine, the last couple weeks went so much better.	I think it's proof. It's physical proof right there where you could actually see it and address it.
Special Education	Rachel	It helped you see certain things that you weren't realizing before.	I think the video really helped me to give feedback on specifically what they were trying to target and specifically what they were trying to look at.	After the first video I thought well, let's try something like this, and it worked really well. There's a little bit of that pressure to say, see look I can take your suggestions.	And then obviously, obviously there were changes made because you can see from video to video the difference in the participation level.
	Amy	Video analysis causes you to really look. Really, really, look and realize that that's not good or that wasn't a smart choice to make.	When you take one general problem to another teacher, but they can't see it, and you can't really explain it to them the way you saw it, their suggestions are too general.	It almost forces you to have to set goals and follow through with the things that you said and things that other people commented on because they'd like to see a change but you want to see a change and you want to see the change in the child. I want to see change in my teaching but then more importantly I want to see the kind of changes that occur in the child because of the changes that I make.	I was just more pleased when the video was done and I saw that I was fun.
	Jen	This was a good way to actually pinpoint things.	You can see it and their suggestion is more relevant right at that very moment because you remember what it felt like to be in there at that very moment.	When you just think, 'Hey, I should make that change,' it's harder to actually do it than if you see yourself do it and say, 'Oh I really need to do that.' Knowing that you're going to be videoed again, and you have to watch it again, I think makes me more apt to change.	After showing her video she said, "That was ten times better."
English Language Learners	Melissa	If I watch it, I realize it, and I take notes about it, and I'm trying.	I think the video helps because we can say, 'Oh, stop, rewind, let me see that again,' or we can all say, ' Remember that part when. .. ' so having it on the video, it's all focused on whatever the camera was focused on at that time, so we can all reference the same things	It gives you an opportunity to change specific things that you want to change, and it's not something that a mentor is telling you to change or something that a teacher is telling you to change, but it is something that you are really looking at in your own teaching and finding that you want to change.	I felt like I was doing one thing, but I wanted to see, actually see, what was happening.
	Betsy	I don't think I can change it if I don't notice it.	I can tag little parts of the video and then have someone watch it and the other people might see something different that I didn't see myself.	Without video I might have just gone the whole semester not really focused on anything specific and just kind of taught and tried to get better at teaching in general, but not really able to change anything specific.	It can boost my confidence because I think oh good, I am teaching alright, I am getting to be a better teacher than I thought I was. So it is a good thing for myself confidence. That and people can't really show me without me seeing myself.

when you can step back as an observer, you see more things and have a desire to change." Gaining a new perspective on the teaching situation helped teachers to identify issues of which they were not previously aware. For example Jen said, "After watching the video, I noticed a lot about myself, but even more about the kids. I noticed little cues or little things that you miss while you are interacting with them." Erin, who focused her analysis on checking for understanding, told Kristy during their discussion,

The sad part is that not once, not once, did I check for understanding. I assumed that they understood, but I didn't ever say,

"Now does that make sense? Or is this clear? Do you have any questions?" Anything like that.

As the teachers watched their videos, they often seemed surprised when what they viewed was different from what they remembered.

3.1.2. Focus the analysis
Prior to this study, the teachers reported that they typically received feedback on their teaching from classroom observers, reflecting from memory, student ratings, or workshops. Teachers

Table 2
Recognize the need to change.

Factor	Explanation	Reported benefits
Gain new perspective	Teachers gained a new perspective on their teaching.	Using video analysis was easier than reflecting in action. Teachers were able to identify issues of which they were not previously aware.
Focus the analysis	The analysis was focused on specific aspects of teaching.	Video analysis was more specific than feedback teachers had typically received on their teaching. Teachers were able to focus their reflections on two or three aspects of teaching.
See with own eyes	Teachers were able to see both their strengths and weaknesses with their own eyes.	Teachers trusted video analysis feedback because they were able to see the need to change with their own eyes. Video analysis helped teachers recognize issues that they were not previously willing to accept.

said the feedback they received from these methods tended to be very general. For example, Erin said that she had been observed every year for the last five years, but the feedback she received was not specific enough to help her make improvements to her teaching.

> The person observing would say, "Oh, it was so great. You did such a good job." And that's about it. But I can look through MediaNotes and say, "Oh that was a poorly asked question," or "Look at that right there. That was good, but I should have followed up with this." I think using MediaNotes is more beneficial because I'm more honest with myself than sometimes critiquers would be.

Participants also commented that the issues they remembered from their lessons tended to be very general. Erin said, "I think the one thing I love with the video analysis is that I can see myself, and I don't have to remember." The teachers often realized that several things in their lessons did not go as planned. However, at the end of the day, when they actually had time to stop and reflect, they couldn't remember everything they had recognized throughout the day. Amy compared trying to reflect from memory to going grocery shopping without a list.

> If you try and go to the grocery store, and you are like "These are the things that I need." And you go without a list and are just trying to remember, you may forget some things. With reflecting from memory, I get done, and I'm like, "There was this thing that got one of the students upset, but I don't remember why." But when you watch it back you can say, "Well at that specific time right there, I did that and lost a kid." I don't have to remember everything.

Several teachers mentioned that when they reviewed their teaching with a classroom observer, it was difficult to remember everything the observer identified about their teaching. Erin said,

> If a teacher comes in on any given day to watch and then they say, "Remember this part?" Sometimes I'm trying my best to recall it, but I can't. Whereas if you have the video, you can watch yourself again and see "Oh, I didn't realize I do that." There is value in seeing rather than just hearing.

When teachers were unable to remember the events described by the classroom observer, they felt that it was difficult to recognize the need to change. In contrast, replaying video clips seemed to help teachers to better understand the comments made about their teaching. Betsy said, "Without video I might have just gone the whole semester not really focused on anything specific and just kind of tried to get better at teaching in general, but not really been able to change anything specific."

3.1.3. See with own eyes

Teachers also said that they were more likely to change their teaching when they saw the need to change with their own eyes because they trusted their own eyes more than other feedback methods. Amy said, "Sometimes you know you are supposed to change something, but you don't really do it. You don't really recognize the need to change until you see it on the video." After doing video analysis, the teachers often recognized issues in their teaching that they were not previously willing to accept. For example, Melissa had been told several times by her supervisors that she did not teach to the whole class, but she never addressed

the issue. After watching her video she said, "I noticed, especially through watching the video, I always turn to the left side of the class and stand on the right side. I just talk to the left side of the class." Melissa said she finally addressed the issue because "every time I got in front of the class I thought: Who am I standing by? Where am I standing? Where am I in the classroom?" As a result of the changes she made, she no longer has "students that are sleeping."

Amy explained that sometimes she recognizes when an activity is not going well, but does not address the issue because she convinces herself that it isn't too bad or that it does not matter because there is not much time left for the activity. She said, "Teachers don't want to critique themselves or say they could do better because it's easier to say that you are already perfect." Amy explained that watching her videos forced her to accept the need to change.

> If you actually videotape it, and you go back and watch it, then you are forced to see yourself actually making the mistake. As I watch myself, I think the whole time, "I really need to do something differently."

3.2. Brainstorm ideas for change

After teachers recognized the need to change their teaching, they brainstormed ideas to improve future teaching situations. Teachers brainstormed individually as they analyzed their teaching videos in MediaNotes and then collectively as they met with other teachers or a supervisor. Teachers commented that the ideas suggested during the video analysis process were better than the ideas generated when they tried to reflect on their teaching from memory because video helped everyone understand the situation. As a result, the ideas individually brainstormed and the group suggestions usually addressed their specific teaching needs. Table 3 lists the factors that seemed to influence teachers' abilities to brainstorm ideas for change.

3.2.1. Identify specific changes

Some teachers commented that the suggestions they typically received about their teaching were too general to help them

Table 3
Brainstorm ideas for change.

Factor	Explanation	Benefits
Identify specific changes	Teachers were able to brainstorm specific ideas	Teachers were able to identify specific ideas to address their individual challenges.
Gain new perspective	Group brainstorming sessions helped teachers gain a new perspective on their teaching.	Discussion groups were able to help the teachers see their teaching from another perspective and point out things teachers missed when they reflected individually.
Focused discussion	Discussion was focused around specific clips which the teachers marked.	Teachers felt that discussions were better because the group was able to offer more personalized suggestions.
Express empathy	Discussion group was able to express empathy.	Teachers felt like the group could relate to their situation. Therefore, they were more open to their suggestions.

improve. Teachers said that they often went to other teachers for advice, but they were only able to describe the general problem with which they were struggling. Amy explained, "When you take a general problem to a teacher, they can't see it, and you can't really explain it to them the way you saw it. Then when you go back to try and fix the problem, it doesn't help as much. It doesn't help you think of specific changes." Teachers said the suggestions during the video analysis conferences were more relevant and specific to their needs. "The group could see exactly what was happening, and they wouldn't just assume. They could see the way that I handled it, instead of me just explaining how I handled it or what I thought was going on." After watching a clip, teachers would pause the video and ask, "What do you think? What thoughts do you have for that?" The teachers seemed to use the video to demonstrate specific situations that they had questions about. For example, after showing a video clip, Erin said, "I found that's the way I check for understanding. Do you think that was a good way? Do you think I am making people feel dumb?" At the conclusion of one of Jen's clips she said, "There again after watching this, you can tell that this is where I struggled." Then she put her hands up in the air and said, "Suggestions?" The other teachers were able to offer suggestions that dealt with the teachers' specific situations. As a result, teachers commented that they were more likely to implement the suggestions.

3.2.2. Gain new perspective

Teachers felt that sharing their teaching with others helped them to gain a new perspective on their teaching because the group was able to "see different things than I saw." Kathryn said, "My best ideas come out of talking to other people." In particular, Rachel who was trying to improve story time in her classroom said, "Discussion for me was the most helpful. I don't think I would have thought to look at my book choice had we not had that discussion."

3.2.3. Focused discussion

Video analysis seemed to allow teachers to focus their discussions around specific issues where they might need change. Kathryn commented, "If you had three teachers in a classroom observing, you'd probably all see something different because everyone's eyes would be going to different places at different times. The video helped everyone focus on the same situation and allowed us to reference the same things." Video also allowed the teachers to review specific clips several times. Teachers often said, "Stop. Rewind. Let me see that again." Then they would discuss and clarify what was happening in the video. Video seemed to help the teachers to anchor their conversations around specific clips. Additionally, the discussion groups felt like video analysis helped the group to understand the teachers' rationales for their instructional decisions. As teachers showed the video clips, the other teachers read the written comments on each clip. Often the group would say, "Stop. What do you mean right there?" Then the teacher would explain what she had written and why she had made the comment. Amy said, "Being able to read the comments kind of made us be able to

think about how they were thinking about the situation." As a result of being able to understand the context of the teaching situation, the discussion groups felt like they could offer better suggestions.

3.2.4. Express empathy

The video seemed to help the teachers relate to each other. After watching the video clips, the discussion groups typically empathized with the teacher. They would say things like, "That's really difficult. If I recorded myself, I would probably do it more than I realize." Then the teachers would offer suggestions. "I do that too, so what I want to try to do is…" or "I have that problem too, so one thing I think I'll try is…" It seemed important to the teachers to know that the group had struggled with similar problems. After showing a video clip, Kathryn asked, "Do you ever do that?" It seemed like she wanted to know that the teachers could relate to her issue. Teachers said they were more open to taking suggestions when they felt like the group could relate to their specific situation.

3.3. Implement ideas

The next stage in the change process was for the teachers to implement some of the ideas that were brainstormed. Teachers commented that they typically implemented ideas that were generated during the video analysis process because the ideas usually addressed their specific needs and because they were allowed to select the ideas that they felt were best for their particular situations. Teachers also commented that vivid images from the video and repetition of watching themselves on video helped them to remember the ideas they wanted to implement in future teaching situations. Table 4 lists the factors that appeared to influence the changes teachers implemented in their future teaching.

3.3.1. Ownership

Teachers reported that they were likely to implement the ideas that were generated during the video analysis discussion groups because they felt ownership over the reflection process since they had chosen the focus of their reflection and selected the video clips they wanted feedback on. Jen compared video analysis to classroom observations. She said that when someone observes her class, "I always feel like I have to make the goal they want me to make and it's not very personal, and so I feel like I just don't try very hard to change when it's someone else setting the goal." In contrast, Jen said that video analysis, "made it a lot more personal. I actually analyzed myself doing that rather than someone else telling me what I did wrong. I don't necessarily want to do something just to please other people."

Melissa said,

[Video analysis] gives you the opportunity to change specific things that you want to change and it's not something that a mentor is telling you to change or something that a teacher is telling you to change, but it is really something that you are

Table 4
Implement ideas in future teaching situations.

Factor	Definition	Reported benefits
Ownership	Teachers reported that they were more likely to implement ideas that were generated because they felt ownership over the reflection process.	Teachers felt like they had ownership over ideas that were generated because they chose the focus of their reflection, selected the video clips and situations they wanted feedback on.
Accountability	Teachers felt accountable to implement ideas that were generated in their discussion groups.	Teachers often implemented ideas that were generated in their discussion groups because they felt accountable to show the group that they were trying to improve their teaching.
Vivid images	Videos created vivid images in teachers' minds which helped them remember the changes they wanted to make.	Teachers remembered the changes they wanted to make while they were writing their lesson plans and while teaching future lessons.
Repetition	Teachers were able to look at their video and analysis multiple times.	Looking at the videos and analyses multiple times, helped teachers remember changes they wanted to in future teaching situations.

really looking at in your own teaching and deciding you want to change.

Even though many of the ideas that the teachers implemented came from the suggestions during the discussion groups, teachers seemed to feel ownership over the ideas they implemented.

3.3.2. Accountability

After brainstorming with the discussion group, teachers said they felt accountable to show the group they had implemented some of the suggestions that were offered. Rachel commented,

I would definitely be more likely to change because they know I'm working on this, and I know I'm working on this, and I want to show that I really did make an effort. There is a little bit of pressure to say, "Look, I can take your suggestions."

Amy said, "You wanted to hear [the group's] approval of "That was really good. You took the things that we said, and you followed through with them, and it worked, and we see it." Additionally, Betsy commented, "I want to see that it is better, and want to see that they can see some improvement." Accountability, knowing that others would expect to see some sort of change, therefore became a key motivator in the process.

3.3.3. Vivid images

The video images appeared to help participants remember to implement changes into their lesson plans. For example Melissa, who was trying to use more open-ended questions in her lessons said, "In preparing for class I've been more aware of making open-ended questions in my preparation and not just waiting until I get to class and thinking that I can just come up with the questions." Teachers also said that the video images popped into their minds while they were teaching and reminded them to make changes. Amy said, "All of the sudden you are replaying the last video in your mind. I can see the kids start to do the same thing. Then I remember, 'Oh, I saw that in the last video and this is what the teachers suggested that I do and this is what I suggested that I do. Then I try to fix it." Kathryn said, "I would be teaching, and I would actually see myself on this little screen, and I remember, 'Oh, I did that,' or 'Oh, I did that.' And it has helped me to remember what I wanted to change."

Teachers mentioned that after watching their videos they were more conscious of what was happening while they are teaching. Melissa said, "It makes me more conscious in class because when I saw it on the video, then during class I realize, 'Oh, I remember seeing this on the video, and I don't want to do this.'" Teachers said, that "even when [they] are not recording, [they] notice the things that [they] tagged in [their] videotapes."

3.3.4. Repetition

Teachers liked recording their teaching because it created a "permanent product that could be reviewed as many times as you need." The teachers said that reviewing the video helped them remember the changes they wanted to implement. Amy reviewed one of her videos 10 times. She said, "It wasn't like I was trying to

beat myself up even more every single time, but it helps. It reminds me of something I'm forgetting, and so the next time I do the activity, I remember the video."

3.4. Evaluate changes

Teachers typically evaluated the changes they implemented by reflecting from memory or by using video analysis. Teachers usually recognized when their teaching improved by reflecting from memory, but it seemed that video was used as proof to themselves and to others that their teaching actually improved. Teachers also liked the formative nature of the video analysis process because it focused on formative improvement rather than applying a final judgment. Table 5 shows factors that the teachers felt were beneficial in helping teachers evaluate the changes they made.

3.4.1. Proof

Although teachers often recognized that their teaching was improving, it seemed as if they used video to prove to themselves that their teaching actually improved. After Amy finished her second lesson she said, "I was so happy. I was really happy that [a student] was with me the whole time, but after the video was done, I was just more pleased. I was like, 'Oh, I was fun!'" It was as if Amy used the video to prove to herself that she really was better. Erin explained that "video gave more concrete examples to whether I had done good or bad, so it was more than just a feeling of 'Did I do well? I think I did okay.' It was more concrete."

It also appeared that teachers used video to prove to their discussion groups that their teaching was getting better. For example, Erin introduced one of her clips by saying, "This is what I tried to do…Let's see how I did." Then she showed the clip to Kathryn. Although Erin already knew she had done well, it was as if she wanted the video to prove it Kathryn. Kathryn responded, "I like that. That's cool. I like how you got them moving." Discussion groups also seemed more excited to see rather than listen to the teachers describe what they did well. As Betsy and her supervisor watched the videos together, the supervisor would occasionally blurt out, "That was great!" The supervisor seemed to have a lot more excitement as she watched Betsy do something great compared to when Betsy told her what went well in her lesson. It seemed like it was clearer to the supervisor that Betsy really had done something well. Erin described the video as "proof." She said, "It's proof. It's physical proof right there where you can actually see."

3.4.2. Formative evaluation

The formative nature of video analysis was motivating for the teachers because there was still time to change their teaching practices, they could see their progress, and the process was focused on helping them improve rather than assigning a final judgment about their teaching. Kathryn mentioned that she thought student evaluations were beneficial, but she had "to wait for the end of a full term to get the feedback." She said, "With the video, you can do it one day and say, 'Oh you know, that was not

Table 5
Evaluate changes.

Factor	Definition	Reported benefits
Proof	Teachers felt that the video evaluations served as proof that their teaching improved.	Teachers liked seeing their teaching improve in each of the videos. Teachers liked knowing that the discussion group could see their progress.
Formative Evaluation	Teachers were able to evaluate themselves prior to any final judgments being made about them.	Formative evaluation was motivating for the teachers because there was still time to change their teaching practices. Formative evaluations were motivating because the teachers could see their progress. Teachers felt like the video analysis process focused on helping them improve rather than applying a final judgment to their teaching.

good.' Two weeks later you can do it again and say, 'Okay, I'm improving. I'm doing better.'".

Amy said, "I was able to see a huge change from my very first videos to my last video even though the very first time I tried video analysis, I was thinking to myself, 'there's not going to be a huge change.' But because of the constant week by week changes that we are trying to work on, little by little I was able to make huge progress."

Teachers were motivated when they could see themselves improving. Rachel watched story time change from "part of the day that everyone viewed as not very fun" to "a really fun time." She said,

Before, when it was story time, the kids would go everywhere and everybody was trying to re-gather them. But by the time we got to that fourth video, we'd say, "story time," and half the class was over there in their seats before the staff could tell them to go. They were so involved in the stories and so excited about the stories, where before they hated story time.

Teachers also appeared to be motivated when their discussion group complimented them on their progress. The groups said things like, "Wow! That was just amazing. That was heads and tails above the last time. Look at that. Look at that! I think we should keep that video on file. I think that's a good example." The compliments motivated the teachers to continue to work on their goals.

4. Discussion

Previous studies reported several benefits of using video for teacher reflection (Fadde & Rich, 2010; Brouwer, 2011; Tochon, 2008). However, few studies addressed how video analysis influenced the process that led teachers to change their teaching. In this study, each teacher made changes to their practices after participating in the video analysis process (see Table 1). From the previous evidence, we noted six over-arching themes that may help researchers and educators better understand how video can be used to improve teacher development. Teachers reported that video encouraged change because it helped them: (a) focus on key aspects of their teaching, (b) gain a new perspective, (c) trust the feedback they received, (d) feel accountable to change their practice, (e) remember to implement changes, and (f) see their progress.

4.1. Ability to focus on key aspects

Teachers felt that video analysis was beneficial because it helped them narrow the focus of their reflection. This is not surprising since Brinko (1993) claimed that narrowing the reflection focus can help teachers avoid a shallow analysis of their teaching. The use of video analysis enabled a tightened focus by slowing down the fast pace of the classroom and allowing teachers to focus on specific aspects of their teaching. Since teachers chose two or three aspects of their teaching to focus on, it was easy to identify both positive and negative examples in their videos. Teachers compared video analysis to a grocery list which helps individuals stay focused on particular tasks in the store; video analysis helped teachers remember to focus on specific aspects of their teaching rather than getting lost in the complexity of the classroom environment.

Participating in a focused analysis also helped teachers identify specific changes they wanted to make to their teaching. Teachers commented that the feedback they typically received on their teaching was too general to make specific changes. Brawdy and Byra (1994) stated that specific information is essential when providing feedback to teachers. Video allowed the teachers to see specific examples of how they were doing with each aspect of their

reflection focus. Additionally, video allowed the discussion groups to see and understand the teachers' individual needs. As a result, the group was able to offer specific suggestions that addressed their individual teaching needs. Carroll and Goldberg (1989) stated that narrowing the reflection focus can help others make relevant observations and recommendations. Bliss and Reynolds (2004) further noted that gaining such a focus has helped novice teachers understand the complexities of teaching more fully. Since the discussion was focused on specific video clips, teachers were able to receive relevant suggestions that addressed their individual needs. Receiving specific and relevant suggestions made it easier for teachers to change their future teaching.

Interestingly, despite (or perhaps due to) the increased focus on specific aspects of teaching, teachers in this study regularly reached a saturation point. After repeating the analysis process three times with the same codes, teachers felt that they had "improved enough" and were ready to move to another aspect of their teaching. Therefore, many of the teachers felt like the fourth round of video analysis was not very helpful, and some teachers actually decided to change the focus for their fourth analysis. Furthermore, though teachers in this study focused on two or three aspects of their teaching, some researchers suggest further narrowing reflection to a single goal or skill (Brinko, 1993). Additional research is needed to determine the ideal number of items teachers should focus on during their video analysis and across how many lessons teachers should focus on those items.

4.2. Gain a new perspective

When individuals are entrenched in their environment, it is difficult for them to consider their situation from another perspective (Hamilton, Pinnegar, Russell, Loughran, & LaBoskey, 1998). As teachers watched their videos and discussed their teaching with others, they were able to gain a new perspective on their teaching. This is a common finding of many video analysis studies (Rich & Hannafin, 2009; Tripp, 2009; Grainger, 2004; Miller & Carney, 2008). Video allows teachers to become an observer of their own classroom (Seong & Broderick, 2003). Bryan and Recesso (2006) described this as the ability to "step back from the practice" (p. 34) in order to review the event. Teachers in this study also reported the ability to "step back as observers" and notice issues in their teaching which they could not recall from memory or which they had not attended to during their lesson. Loughran (2006) noted that unless an issue is recognized as a problem, teachers are unlikely to change.

The teachers in this study followed a curious pattern wherein they reported that they were more likely to believe another teacher's recommendations once they witnessed the said event on video. One possible implication of such a confession is that neither video nor non-video feedback takes precedence, but rather the combined nature of receiving feedback and then being able to witness it one's self. This suggests that supervisors who give feedback might have greater buy-in from teachers when highlighting something about their practice and then showing that on video. This study doesn't examine in what direction this should happen (e.g., first receive the feedback and then show video or vice versa). However, we caution against assuming that video, coupled with feedback from another teacher, will invariably increase the credibility of such feedback and help the teacher to see her practice more clearly. One only needs to look to Bryan and Recesso's (2006) work with science educators to find a situation where a teacher's beliefs about his practice were so entrenched that even seeing a clear contradiction of his practice on video did not result in the teacher seeing what others saw in his practice. Nonetheless, as teachers recognized problems in their teaching videos, they were

more willing to accept the fact that their teaching needed to change. Thus, acknowledgment of a problem, and not merely the coupling of feedback with video, may have been the more important factor in initiating change in a teacher's practice.

4.3. Increased trust in feedback

The aforementioned acknowledgment could not have been obtained without a teacher's explicit trust in the sources of feedback. Throughout the study, teachers continually talked about trusting video analysis feedback more than previous feedback methods they had used. Brinko (1993) reported that feedback is most effective when teachers view the source as credible. In this case, video served as a credible source, which allowed teachers to see with their own eyes, and perhaps more importantly, believe in the need to change. Although teachers trusted the video more, it is possible that combining video with other feedback methods would increase their trust in the feedback received from those methods. Future research should investigate whether combining video with other feedback methods increases teachers' trust in the feedback.

Brinko (1993) indicated that instructors need to view feedback sources as "knowledgeable enough to make an accurate judgment" (p. 577). Teachers trusted the ideas that were suggested during their discussion groups because the group had a common frame of reference and could see their specific challenges. Teachers felt like the groups' suggestions were based on "objective information." Brinko also recommended that "feedback is more effective when it contains irrefutable evidence" (p. 579). In the teachers' minds, video served as "irrefutable evidence" on which the group based their suggestions. Since teachers trusted feedback given by the group, they were more open to implementing the suggestions offered.

Teachers in this study selected their own discussion groups. The teachers selected their supervisors, colleagues, and in some case both. It is possible that the trust teachers felt toward their group's suggestions was partially due to who they selected to be in the group. This dynamic could be very different in cases where the supervisor is assigned to observe and provide feedback to a teacher. Future research might investigate whether teachers feel the same level of trust when they use video to discuss their teaching with individuals they did not self select.

4.4. Motivated to improve

Increased focus, acknowledgment and trust seemed to be important considerations in moving teachers to action. Teachers reported that participating in a video analysis process helped teachers feel *accountable* to improve their teaching. After watching their own videos and sharing their videos with others, it was difficult for teachers to deny that certain aspects of their teaching needed to change. Teachers felt accountable to themselves and to their discussion group to show progress. Each time teachers recorded a lesson, they wanted to see improvement. Ilgen, Fisher, and Taylor (1979) indicated that feedback associated with rewards or punishment can motivate individuals to change. Seeing improvement in the videos and hearing the compliments from the discussion group served as a reward to encourage teachers to change. Teachers were also motivated by fear of seeing the same mistakes in consecutive videos or having the discussion group recognize that their teaching did not improve. Similar to Rosaen, Lunderberg, Cooper, Fritzen, and Terpstra (2010), teachers in this study put more effort into their analysis because they knew they would be sharing it with others. Teachers wanted to be able to show their discussion group that they listened to their ideas, made changes, and actually improved their teaching.

4.5. Improved memory of desired changes

Not only were teachers more motivated to make changes they believably saw through video and discussion, but the use of video helped them to replay and "see" again during teaching. While instructors were teaching, the images seen in their videos often appeared in their minds. The images reminded them of the suggestions they had written during their analysis, as well as the suggestions offered during their discussion groups. As the images and suggestions entered their minds, they were able to make immediate adjustments to their teaching. Teachers felt that video helped them "think on their feet." Schön (1983) described this ability as "Reflection in Action" or "building new understandings to inform our actions in the situation that is unfolding" (p. 83), claiming that it is important for teachers to be able to reflect both after the lesson and in the moment. It is possible that video is not only beneficial for helping teachers reflect after their lessons, but is also an effective means for helping teachers develop the ability to reflect in action. Future research should investigate whether teachers improve their ability to adjust their teaching in the moment when they use video to reflect.

4.6. Ability to see progression

Teachers liked the formative nature of the video analysis process better than evaluations they typically received because they had time to make adjustments to their teaching, and they could see their progress across their videos. Rezler and Anderson (1971) stated that feedback is more likely to lead to lasting change when repeated exposures are used. Repeating the video analysis process several times allowed teachers to see their progress. Although they often recognized that their teaching was improving, video served as additional proof to themselves and to their discussion group that they were actually getting better. Additionally, watching the video to evaluate their progress allowed teachers to identify specific things that improved in their teaching, as well as specific things they still needed to work on. Teachers in this study participated in the video analysis process four times. Future research might look at the ideal amount of times the process should be repeated or the amount of time between each analysis.

5. Conclusion

This study examined how video analysis influenced the process that led teachers to change their teaching. By focusing on the change process, researchers discovered several findings that have implications for those interested in using video for teacher reflection. Namely, participating in video reflections increased teachers' desires to change their teaching; when teachers could see the need for improvement with their own eyes, they reported that they could no longer deny or pretend that their teaching did not need improvement. The implication is that, where teachers see no need to change their practice, participation in video reflection may alter that view and create an intrinsic desire to change.

Had teachers only felt a need to change, the study would likely have been less fruitful. Teachers reported they understood more clearly *how* to change their teaching because the ideas they brainstormed, as well as the group's suggestions, were context specific. Consequently, when the teachers returned to the classroom to teach, vivid images from the video and repeated viewings of the video helped them remember to implement the changes they decided to make to their teaching. They reported being able to literally "see" their prior teaching while in the middle of subsequent lessons due to their prior video reflections, providing

evidence that video reflection lead to effective *reflection in action* (Schön, 1983)

An underlying thread throughout our examination of the change process seemed to be that of accountability. Teachers felt accountable to the group to implement some of their suggestions. Tochon (1999) long ago suggested the importance of teachers meeting as a group to review their teaching. As Wu and Kao (2008) discovered, peer feedback can help teachers to see things they would not have noticed themselves or even things they knew they were doing, but supposed were too small to be noticed by others (and were surprised that their peers picked up on!). The group became an essential element for our teachers and their own accountability. They also wanted the group to see improvement in each of their videos. Consequently, teachers reported that the praise from others was very motivating. This notion of increased accountability warrants further consideration. The vast majority of teacher improvement and performance efforts seem to be extrinsically driven. In this case, though, the underlying thread of our participants' change process seems to have been an increased inner desire to account not only for prior practice, but for evidencing their own process of change. Future research ought to examine whether or not this video-generated accountability leads to effective classroom change. As the interest in using video for teacher development and certification increases across the world, administrators and researchers ought to take note of the powerful effect simply placing teachers together with their peers and video evidence of their own teaching can have on creating a sense of accountability for improving one's own teaching. The desire to change and the need to feel accountable for such change can be a powerful change agent in itself.

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