Impact of Critical Events in an Animated Classroom Story on Teacher Learners' Online Comments[1]

Vu Minh Chieu
School of Education, University of Michigan
vmchieu@umich.edu

Wendy Aaron
College of Education, Oregon State University
wendy.aaron@oregonstate.edu

Patricio Herbst
School of Education, University of Michigan
pgherbst@umich.edu

Abstract

We examined the effect of reference to critical events in an animated classroom story on the quality of teachers' comments in an online learning experience. We analyzed data using systemic functional linguistics and logistic regression. We found statistically significant evidence that participants made more reflective and evaluative comments and proposed more alternative teaching moves when they referenced critical events than when they did not. The study contributes to validating a theoretical distinction between reference point and reference object in the literature on video assisted, online teacher education: While attached reference objects help learners be more focused and productive, those qualities differ depending on reference points included in those reference objects. This study also provides preliminary evidence to support the practice of selecting clips that deviate from instructional norms when designing video-based professional learning opportunities.

Introduction

This paper examines the impact of critical events in an animated classroom episode in geometry, which we take as an example of *reference points* (Wise, Padmanabhan, & Duffy, 2009), on the nature of teacher learners' comments within an online learning experience. This online experience revolved around animated representations of instruction in which cartoon characters were used to represent the teacher and students (Herbst, Chazan, Chen, Chieu, & Weiss, 2011). By critical event, we mean a moment of the episode in which instructional norms (Herbst & Chazan, 2003) are breached. For example, in a geometry lesson when the teacher presents a problem for which students are to produce a proof, but without providing statements that clearly identify the 'givens'

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and 'prove,' s/he is breaching a norm of how proof tasks are assigned in American high school geometry classrooms (see Herbst, Aaron, Dimmel, & Erickson, 2013).[2]

We are interested in the role of reference points in online learning experiences for teachers. By online experience, we mean a set of consecutive online activities that engage participants in examining and/or discussing multimedia-based representations of teaching (Herbst et al., 2011). We hypothesize that the existence of critical events (such as the breach of an instructional norm) in an attached media artifact will correlate with qualities observed in the comments participants make.

We seek to understand the difference between participants' comments when they refer to a critical event and when they do not. We are interested in whether and how participants evaluate teaching moves (e.g., make a judgment of a teaching action), reflect on teaching practice (e.g., elaborate on implications of an action), and propose alternatives of teaching actions. Those qualities have been critical in teacher education (see more details in the next section). So, we ask the question: *Are there any correlations between whether participants refer to critical events and whether they make evaluative or reflective comments or whether they propose alternative teaching moves*?

Theoretical Framework

Our study is grounded in a number of well-developed notions in teacher education and learning technologies. Firstly, video technologies have been widely used to support teacher learning (Barab, Kling, & Gray, 2004; Fishman & Davis, 2006). Indeed, video records of professional practice provide valuable help for learners to examine teaching practice. The use of animations of nondescript cartoon characters capitalizes on affordances of video and also allows us to control the extent to which the individualities of people and settings appear in the representation (Herbst et al., 2011; Herbst, Aaron, and Erickson, 2013). Of more importance to the current study, animation technologies allow us to create representations of teaching that contain breaches of instructional norms, which we hypothesize provide learners with enhanced opportunities for examining teaching practice.

Secondly, the notions of teacher noticing (van Es & Sherin, 2002, 2008) and reflection (Schön, 1975) have been a mainstay in the literature on teacher learning. The literature recommends that teachers attend to crucial features (e.g., teaching tactics and student thinking) of classroom interaction; and then evaluating and interpreting those features have been fundamental in teacher preparation. These activities have been shown to help teachers propose alternatives moves of teaching and reflect on their professional practice individually or collaboratively (van Es & Sherin, 2008; Zhang et al., 2011). In other words, increased noticing can enrich teachers' knowledge of student conceptions, teaching techniques, and so forth, and therefore deal better with future teaching problems (Zhang et al., 2011). Note that whether evaluating features of classroom interactions should be encouraged or not has been debatable among scholars because of the sensitivity problem of appraising other human teachers' practice (e.g., Jacobs, Borko, & Koellner, 2009; LeFevre, 2004; Seago, 2004; Zhang et al., 2011). Yet, we conjecture that

[2] We don't argue here about the value of providing the 'givens' and 'prove;' we only assert that this practice appears to be normative.

evaluation of practice represented with cartoon characters may provide teachers with positive experiences (see also Chieu, Kosko, & Herbst, in review).

Thirdly, the use of shared artifacts or *reference objects* (van Es & Sherin, 2008; Wise, Padmanabhan, & Duffy, 2009; Zhang et al., 2011), such as written cases and video records of practice, has been crucial in supporting teacher noticing and reflection, especially in online contexts where learners have little support directing their noticing. Our earlier studies (Chieu, Herbst, & Weiss, 2011; Chieu, Kosko, & Herbst, in review) provide evidence that when animations are embedded as reference objects in forums, participants have the opportunity to increase the reflectiveness and consideration of alternatives in their forum entries.

In this study, we extend the notion of reference object to *reference point*. This term was introduced in Wise, Padmanabhan, and Duffy (2009) to refer to artifacts attached to a forum space, but we propose a refinement of their definition, calling the attached artifacts (e.g., a complete animation clip) a *reference object* and saving the expression *reference point* for specific moments or places in the attached artifact (e.g., critical events in the animation). We are interested in the extent to which the presence of reference points is related to the nature of teachers' individual comments.

Methods

We examined records of teachers' participation in an online experience available in LessonSketch (www.lessonsketch.org), a multimedia-based learning environment for teachers to examine, create, and discuss teaching practice (Herbst, Aaron, & Chieu, in press; Chieu & Herbst, 2012). The experience "The Square," is built around the animated episode, The Square. In the animated episode, a teacher poses the question, "What can be said about the angle bisectors of a quadrilateral?" and sets the class to work on making and proving conjectures. The class eventually explores the case of the angle bisectors of a square. The experience breaks up the study of the animated story into four clips. Each clip has several critical events as seen through the lens of instructional situations (see Table 1): Throughout the story there are several events where norms are breached (see Herbst & Chazan, 2003 for how we created those breaches). Note that the norms presented in Table 1 are hypothetical. We have been conducting a number of studies to understand how teachers recognize and value those norms (see also Herbst, Nachlieli, & Chazan, 2011).

Table 1. Critical events in The Square.

Title	Interval	Critical Event	Breached Norm
Clip 1: Presenting the problem 0:00 – 0:53	0:23 – 0:39	The teacher asks about the angle bisectors of a quadrilateral.	The teacher should provide the givens and prove.
	0:39 – 0:46	The teacher asks students to make conjecture and prove them.	The teacher should provide the givens and prove.
Clip 2: Some students' work 0:53 – 2:22	1:08 – 1:11	The teacher calls Alpha to the board.	The teacher should only invite a student to the board if s/he knows what the student is going to present.
	1:22 – 1:35	The teacher lets Alpha draw the diagram.	The teacher should maintain control of the diagram.
	1:41 – 1:46	The teacher criticizes Alpha's idea.	The teacher should encourage students' ideas.

	1:50 – 2:01	The teacher asks the class to do a task based on Alpha's idea.	The teacher should provide the givens and prove. The teacher should control the task that students work on.
	2:05 – 2:11	The teacher repeats Alpha's words "cut the square in half."	The teacher should use mathematical language properly.
Clip 3: More discussion 2:15 – 3:53	2:15 – 2:43	The teacher lets the students use their own language.	The teacher should take authority of classroom discussion.
	2:43 – 2:46	The teacher calls Gamma to the board.	The teacher should only invite a student to the board if s/he knows what the student is going to present.
	2:50 – 3:17	The teacher lets Gamma generalize the square to the rectangle.	The teacher should control the generalization of concepts for the students.
	3:25 – 3:53	The teacher doesn't control or clarify the task for the students.	The teacher should control the task that students work on.
Clip 4: An argument 4:06 – 7:24	4:14 – 4:38	The teacher doesn't call Lambda to the board. The teacher doesn't remove one diagonal that Lambda requests.	The teacher should encourage students' ideas.
	4:50 – 4:56	The teacher doesn't ask for specific when Lambda uses conceptual language (isosceles triangle).	The teacher should clarify conceptual language when needed.
	4:56 – 5:01	The teacher asks "Lambda, what are you trying to prove?"	The teacher should provide the givens and prove.
	5:12 – 5:19	The teacher misunderstands Lambda's idea.	The teacher should interpret students' idea correctly.
	5:29 – 5:45	The teacher reluctantly removes a diagonal according to Lambda's request.	The teacher should be willing to collaborate with students.
	5:56 – 6:02	Lambda says "If you can prove congruent for one side you could prove it for the other."	The teacher should control the generalization of concepts for the students.
	6:02 – 6:22	The teacher looks confused about Lambda's idea.	The teacher should try to understand students' idea better.
	6:22 – 6:36	The teacher doesn't control student interaction and information flow.	The teacher should control classroom interaction.
	6:36 – 6:56	The teacher provides the givens and prove too late.	The teacher should provide the givens and prove at the beginning of the task.
	6:56 – 7:10	The teacher asks for the prove of the statement after Lambda has provided it.	The teacher should give the right order of the task.

The participants watch the four clips in order (Clip1, Clip 2, Clip 3, and Clip 4) and the whole animation at the end. After each clip and at the end, they are asked to respond to open-ended questions, for example, about how they connect their teaching experience with what happens in the animation. While participants are watching clips they can stop the playback at any time and make comments pegged to the current time code (Figure 1). When participants click the "Make a Comment" button, a popup window appears, and they can input their comment which gets added to a "My comments" box (see Figure 1).

For this paper, we analyzed all comments made by teacher users while they were watching animation clips (see Figure 1). There were 62 teachers who joined the experience "The Square," making 245 comments. The system reports included the time code in the animation where the comments were made. We used comments as units of analysis, except for comments in which participants referred to multiple critical and/or non-critical events. In this case we considered the comment to contain two or more units (e.g., the comment in Table 2 has two units; each sentence is a unit). For each clip, we created a frequency histogram to represent the density of comments made at different time codes. This can help us see if there is a difference between how often participants made comments at critical events and at other events.

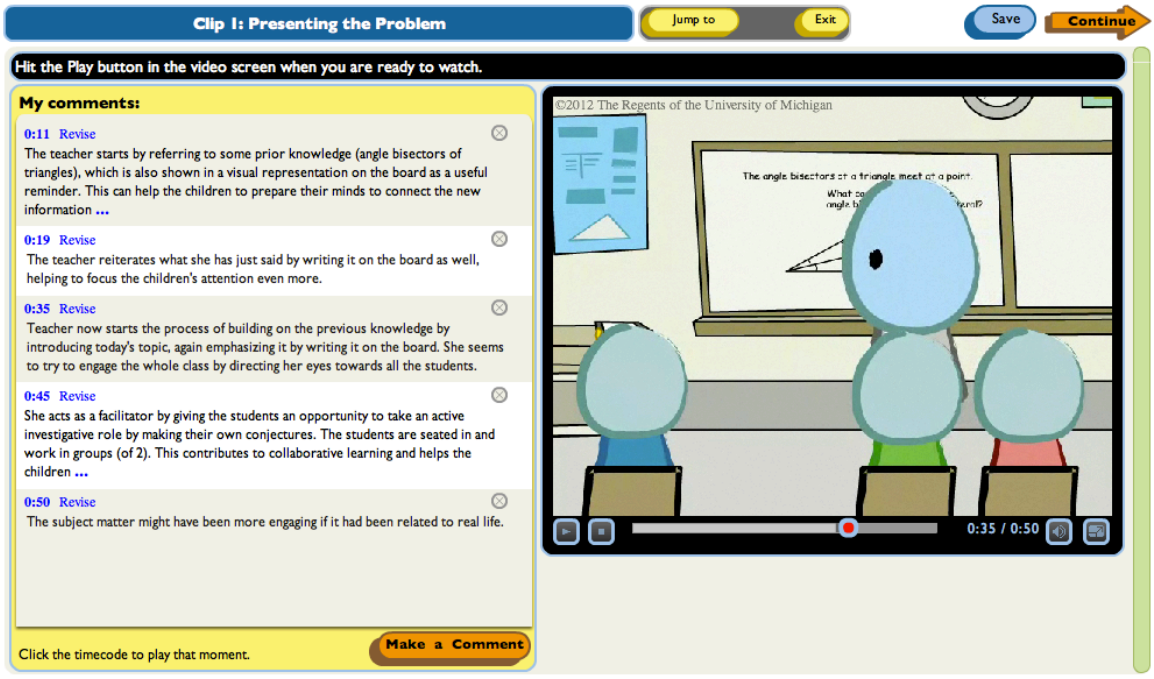

Figure 1. A participant's comments by time code on the first clip.

Table 2. Example comment.

I like [EVALUATION] the idea of reminding the students what was proven the day before, and then using that as a spring board to thinking about what could be proved with the quadrilateral. I also like [EVALUATION] that the teacher said we will see if we can try to prove some of the students conjectures [REFERENCE] - this has a positive and encouraging feel to it [EVALUATION].

To look further into the nature of participants' comments, we used a coding scheme we had developed and validated earlier (Chieu, Kosko, & Herbst, in review). It consisted of the following codes: Reference, Evaluation, Reflection, and Alternativity, as dichotomous variables. Reference was used to code whether participants referred to critical events or not, Evaluation was used to code whether participants made an evaluative comment or not, Reflection was used to code whether participants made a

reflective comment (e.g., reasons why a teaching decision is made) or not, and Alternativity was used to code whether participants proposed alternative teaching moves (e.g., what the animated teacher could or should do) or not. In the following example, we underlined the pieces of comments and added codes next to them.

Table 3. Examples of markers for codes.

Code	Type of Marker	Examples
Evaluation	affect markers	indications of how participants felt such as *like, comfortable with, curious, satisfied* or *dislike, surprised, bored* (see more examples in Martin & White, 2005, Chapter 2)
	judgment markers	indications of how participants assessed people in the animation such as *kind, good* or *bad, mean* (see more examples in Martin & White, 2005, Chapter 2)
	appreciation markers	indications of how they assessed actions in the animation such as *exciting, unique, important* or *trivial, unbalanced* (see more examples in Martin & White, 2005, Chapter 2)
Reflection	causal-conditional conjunctions	enhancement that modifies clauses through variations of logical connections, for instance, *because*, *as*, *since*, *so that, if (then), unless, without* (see more examples in Halliday & Matthiessen, 2004, Section 7.4.3)
	manner or means or comparisons	enhancement that qualifies meaning through comparison or the means in which the process of one clause is enacted, for example, *and thus, and so, by (means of), instead of, which means that, to (in order to), however* (see more examples in Halliday & Matthiessen, 2004, Section 7.4.3)
Alternativity	Use of modals (could, would, should)	"they could work in groups."
	subjunctive mood	"if the teacher provided the givens and prove."
	potential mood	"they would like another problem."
	negative use of indicative mood	"the teacher did not provide students with the givens and prove."

We used elements from Systemic Functional Linguistics (SFL; Halliday & Matthiessen, 2004; Martin & Rose, 2007) to develop indicators for the coding system. SFL is a theory of language that places the function of language as central: Examining how language choices are used to make meaning. We based our coding of *Reference* on an approach proposed by Eggins (2004), who stated: "The cohesive resources of reference refers to how the writer/speaker introduces participants and then keeps track of them once they are in the text. Participants are the people, places and things that get

talked about in the text" (p. 33). We identified whether participants in the study introduced the teacher and/or the students and kept track of their actions that related to critical events. Table 3 shows examples of markers for the remaining three codes. Two coders (the first and second authors) validated the coding scheme: All kappas statistics were greater than 0.6, indicating a good inter-rater reliability (Sim & Wright, 2005). Indeed, the two coders coded 82 comments of the first clip independently. They agreed 94% about creating analysis units, kappa for coding Reference was .61 ($p < .01$), kappa for coding Evaluation .66 ($p < .01$), kappa for coding Reflection .44 ($p < .01$), and kappa for coding Alternativity .77 ($p < .01$). Then, they reconciled all differing codes. Because the inter-rater reliability for Reflection was moderate, the two coders continued to code 71 comments of the second clip for Reflection independently. They agreed 96% about creating analysis units and improved kappa for coding Reflection to .69 ($p < .01$). Again, they reconciled all differing codes. Finally, the first coder assigned all codes for comments on the remaining clips.

To investigate the correlations between the presence of critical events and the quality of teachers' comment, we used Reference as the predictor and the other three codes as dependent variables. Because participants watched clips and made comments individually, we assume that there was no interaction effect among individuals as a group. Comments were nested, however, in individuals. Hence, we applied mixed-effects logistic regression, or hierarchical generalized linear models, to examine the correlations between Reference and the dependent variables.

Results and Discussion

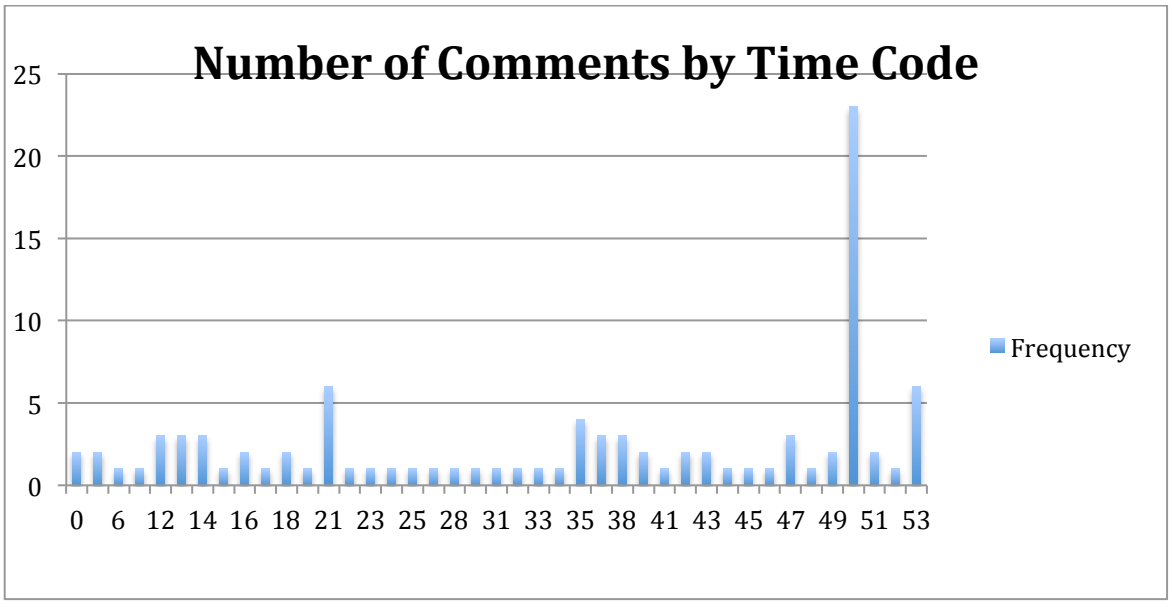

Figure 2. Frequency of comments distributed by time code in the first clip.

Looking at all four frequency histograms showing number of comments by time code (see Figure 2 for example), we found that participants made the majority of comments toward the end of each clip and that there did not seem to be any difference

between the number of comments made at time codes of critical events and that of other events. A reason for this phenomenon could be that all four clips were relatively short and thus many participants waited until they finished watching the full clip to make comments. The content analysis that we describe next provides a more accurate picture of how participants referred to critical events.

Tables 4, 5, 6 summarize frequencies of Reference and the dependent variables in the analysis of comments on all four clips.

Table 4. Frequencies of Reference and Reflection.

Reference	**Reflection**		**Total**
	0	1	
0	88	37	125
1	63	57	120
Total	151	94	245

Table 5. Frequencies of Reference and Evaluation.

Reference	**Evaluation**		**Total**
	0	1	
0	70	55	125
1	32	88	120
Total	102	143	245

Table 6. Frequencies of Reference and Alternativity.

Reference	**Alternativity**		**Total**
	0	1	
0	101	24	125
1	67	53	120
Total	168	77	245

Table 7. Results of logistic regression with all four clips aggregated.

	Probability that comment was coded after dependent variable			
Dependent Variable	*Comments not containing Reference to a critical event*	*Comments containing Reference to a critical event*	*p value*	*Effect Size*
Reflection	27.2%	44.8%	0.007**	2.2
Evaluation	42.5%	72.5%	0.000***	4.1
Alternativity	17.0%	43.8%	0.000***	3.8

Running mixed-effect logistic regression models with aggregated data of all four clips, we found statistically significant correlations between the Reference predictor and the three outcome variables (Table 7), and those correlations do not vary across the four clips. One can interpret the results of Table 7, for the case of Reflection, as follows: A comment that did not contain reference to critical events had a 27.2% chance of including reflection. If a comment did contain reference to critical events, however, then the probability of including reflection increased to 44.8% ($p < .01$). The effect size or odds

ratio is 2.2, meaning that the odds of a comment including reflection if it referred to critical events was 2.2 times higher than the odds of a comment including reflection if it did not refer to critical events. Similarly, the odds of a comment including evaluation if it referred to critical events was 4.1 times higher than the odds of a comment including reflection if it did not refer to critical events ($p < 0.001$) and the odds of a comment including alternativity if it referred to critical events was 3.8 times higher than the odds of a comment including reflection if it did not refer to critical events ($p < 0.001$).

These results indicate strong correlations between the presence of critical events and the quality of participants' comments. This could mean that even if participants annotate animated classroom stories individually and without any facilitator, installing breached norms as critical events or reference points into stories may stimulate them to make more evaluative and reflective comments and to propose more alternative teaching actions, and therefore help them produce annotations with a relatively good quality.

Conclusion

Reference object has been an important construct in teaching and learning, especially in online contexts in which it is difficult to ensure that people stay focused and productive (Collison et al., 2000; Larson & Keiper, 2002; Gunawardena, Lowe, & Anderson, 1997). This study goes further by introducing another important construct: *Reference point*. This study provides evidence that when comments refer to breaches of instructional norms as reference points those comments are more likely to include reflectiveness, alternativity, and evaluation. In other words, using a reference object with breaches of instructional norms installed in it may help developers elicit comments of higher quality from teachers on that reference object.

This study also provides a practical approach to validate the theoretical construct of reference point by looking at the difference between when participants' comments include reference points and when they do not. Finally, this study supports preliminary evidence for a common practice in teacher education: Selecting and editing appropriate clips of video records of instructional practice for teacher preparation and development. Indeed, video records of practice are often very long and teacher educators or developers must cut and select short, generative clips for use in educational settings, such as, video clubs (van Es & Sherin, 2008) or video-based annotation settings (LeFevre, 2004; Zhang et al., 2011). This study suggests that provocative and educative clips will be those that contain some surprising or disruptive moment that could act as a critical event. Indeed, as originally hypothesized by Herbst & Chazan (2003) and confirmed with study group data (Herbst, Nachlieli, & Chazan, 2011; Nachlieli and Herbst, 2009) breaches of instructional norms tend to provoke practitioners to comment and the present data suggests also that the comments they make tend to be better than comments on other moments on the interaction observed.

Regarding whether evaluating features of classroom interactions can be seen as a positive aspect in the online experience described in this study, we shall look further into the correlations between evaluation, as a predictor, and reflection and alternativity, as outcome variables.

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