Videocase Complexity and Preservice Teacher Noticing: Examining the Effects of Cognitive Load

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Abstract: Despite the growing research base on preservice teacher noticing of children's mathematical thinking with video, few studies consider the complex nature of the video representations. Borrowing from cognitive load theory, we coded the complexity of the salient teaching and learning events captured in video and analyzed the relationship between video complexity and PST noticing. Results indicate that videos with higher intrinsic load increase opportunities for noticing, and videos with higher extraneous load negatively affect noticing.

Over the past decade, the use of video to support teacher learning has grown considerably in the field of teacher education (Brophy, 2008). Researchers utilized the construct of *teacher noticing* to understand what and how teachers learn from video (cf. Sherin, Jacobs, & Philipp, 2011). Research on preservice teachers' (PST) noticing in video has demonstrated positive impacts on PSTs' ability to attend to and interpret children's mathematical thinking (CMT). As learning from representations of teaching is dependent on the nature of the representations, we shift the focus of research on PST noticing from what PSTs notice in video to how video representation complexity impacts PST noticing. We focus on the following research question: (1) How does complexity of a video representation impact PSTs' attending to and interpreting of CMT?

Framing

Following Jacobs and her colleagues, we operationalize PST noticing as attending to and interpreting CMT. Our prior research suggested that the use of videocases to support PSTs' ability to notice CMT, in particular, seemed ineffective, particularly as not all video representations are created equal, which has considerable implications for PST noticing in video. Incorporating video clips that are more or less complex in terms of the nature of the teaching and learning events portrayed is particularly important for novices who often struggle to pay attention to CMT in video (Jacobs et al., 2010). Video is a type of representation of complex teaching and learning practices, which highlights the salient events and at the same time masks other events related to the represented events. We define this simultaneous highlighting and masking as video *complexity*.

Borrowing from cognitive load theory, we developed a rubric for analyzing the complexity of the salient teaching and learning events captured in video clips. Cognitive load theory distinguishes between three types of load: intrinsic load, extraneous load, and germane load (Sweller, 2003). Drawing on cognitive load research (Sweller, 2003) and teacher noticing research (Jacobs et al., 2010), we coded *complexity* under two dimensions. The intrinsic load dimension included Depth of Enacted Task, Clarity of Student Thinking, Teacher Participation, Sequential Moments of CMT, Simultaneous Moments of CMT, and Types of CMT. The extraneous load dimension Non-CMT Moments and Visual-Verbal Noise.

Analysis

Two coders followed a 2-stage coding scheme. The first stage assessed whether a PST's response described what the children were doing or saying about mathematics. The second stage of coding explored the degree of evidence (i.e., none, limited, robust) for attending to and interpreting CMT in the PST's response. Two coders were assigned to each videocase, and there was greater than 90% reliability in both rounds of coding. Then, using the video complexity rubric, two coders scored each videocase as low or high on the load-noticing categories and reconciled discrepancies. Seven total videos were scored, ultimately reaching 100% agreement. Data for this analysis comes from 233 PSTs over two semesters of required math courses from an elementary teacher education program at an urban university in a large, Midwestern city in the United States. PSTs were assigned to view videocases for homework during a semester. The data presented unique constraints for the analysis, and so we utilized generalized estimating equations (GEE) for the analysis as it allows for repeated measures analysis (Zeger & Liang, 1986), a working, autoregressive correlation matrix that adjusts for within-observation correlations (Fitzmaurice, Laird, & Rotnitzky, 1993), and an ordinal outcome variable with missing data (Kenward, Lesaffre, & Molenberghs, 1994).

Results and discussion

SPSS was used for the analysis with level of noticing as the outcome variable and cognitive load criteria as the independent factors. Scaffold level and videocase ID were used as within-subject variables. Two redundant covariate, Sequential Moments and Visual-Verbal Noise, and two non-significant variables, Clarity of Student Thinking and Types of Moments, were removed for the second model with results in Table 4. Four cognitive load criteria from our rubric significantly predict the population of PSTs level of attending: Depth of Enacted Task, Teacher Participation, Simultaneous Moments of CMT, and Non-Moments of CMT.

Table 4: Parameter estimates, standard errors (SE), Wald statistics (χ^2,degrees of freedom), corresponding significance probabilities (p), and log odds ratio from the analyses

	Model 1					Model 2				
Parameter	**Est.**	**SE**	**Chi Square (df)**	**p**	**Exp(B)**	**Est.**	**SE**	**Chi Square (df)**	**p**	**Exp(B)**
Depth of Enacted Task	0.268	0.171	2.463 (1)	0.117	1.307	0.322	0.122	6.977 (1)	0.008	1.308
Clarity of Student Thinking	0.060	0.153	0.155 (1)	0.694	1.062					
Teacher Participation	0.600	0.168	12.715 (1)	0.000	1.821	0.614	0.106	33.254 (1)	0.000	1.847
Sequential Moments of CMT	-	-	-	-	-					
Simultaneous Moments of CMT	0.147	0.104	1.997 (1)	0.158	1.158	0.156	0.073	4.496 (1)	0.034	1.168
Types of CMT in Videocase	-0.078	0.101	0.608 (1)	0.435	0.925					
Non-CMT Moments	-0.518	0.121	18.317 (1)	0.000	0.596	-0.527	0.080	43.339 (1)	0.000	0.591
Visual-Verbal Noise	-	-	-	-	-					

Depth of enacted task, significantly impacts PSTs' level of attending ($\beta_1 = .322,\ \chi^2 = 6.977,\ df = 1,\ p = .008$). This outcome suggests a videocase with a high depth of enacted task resulted in a higher percentage of PST responses that attended to CMT *and* discussed the strategy being implemented by the child(ren). In other words, a PST can attend to CMT with some degree of recognition of strategies if more opportunities are presented to the PST. The intrinsic cognitive load criteria, teacher participation, significantly impacts PSTs' level of attending ($\beta_3 = .614,\ \chi^2 = 33.254,\ \mathrm{df} = 1,\ \mathrm{p} = .000$). This outcome suggests the presence of a teacher in a videocase who asks questions to elicit CMT lowers the level of attending by the population of PSTs. In other words, PSTs seem to attend to CMT and attend with more interpretation when a teacher is not asking children questions to elicit thinking. The intrinsic cognitive load criteria, simultaneous moments of CMT, significantly impacts PSTs' level of attending ($\beta_5 = .156,\ \chi^2 = 4.496,\ df = 1,\ p = .034$). This outcome suggests, aligning with the findings of the depth of enacted task dimension, the population of PSTs can attend to CMT at a higher level if more opportunities for attending to CMT are present, even when simultaneously presented in a videocase. The intrinsic cognitive load criteria, non-moments of CMT, significantly impacts PSTs' level of attending ($\beta_7 = -.527,\ \chi^2 = 43.339,\ df = 1,\ p = .000$). This finding suggests non-moments of CMT in videocases present additional, extraneous cognitive load on the population of PSTs and reduces the level of attending to CMT by the population of PSTs.

In addition, two of our hypothetical cognitive load criteria, clarity of student thinking and type of CMT, did not significantly impact the population of PSTs' noticing of CMT as hypothesized. While no conclusions can be drawn, this suggests further research is necessary, particularly on the relevance of clarity of student thinking due to its prevalence in noticing research. In sum, as research on PST noticing continues to evolve, researchers should consider the nature of the video representations used in their work, and the relationship between what PSTs are attending to and how they are interpreting the captured events.

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