Examining How Students Make Sense of Slow-Motion Video

Min Yuan, Nam Ju Kim, Joel Drake, Scott Smith and Victor R. Lee
Utah State University, Logan, Utah
min.yuan@aggiemail.usu.edu, {namju1001, jrichdrake}@gmail.com, {scott.smith1, victor.lee}@usu.edu

Abstract: Slow-motion video is starting to appear in science classrooms as a source of data for students to examine. However, seeing important features in such video requires a particular kind of student engagement and supported acts of noticing. This poster reports on an exploratory study of what students noticed and talked about when viewing slow-motion video during a classroom design experiment focused on bodily activity as it relates to motion and animation.

Introduction

Slow-motion video (SMV) is an important way for scientists to analyze physical phenomena (e.g., Mazur, Krehbiel, & Shao, 1995). SMV is created when cameras capture motion at high framerates (>120 frames per second); when this video is played back at a standard rate (~30 fps), the motion is slowed. As prices drop for camera equipment necessary to generate high quality SMV, such video is being integrated into school science curricula (e.g., Heck & Uylings, 2010). With SMV capture capabilities being built into smartphones and other mobile devices (e.g., point-of-view cameras), we expect more classrooms will turn to SMV as a source of data for students to use during classroom inquiry experiences. These SMV capture devices can facilitate students' noticing and observing of complex phenomena that are otherwise invisible, such as the frequency of oscillation in the intensity of a light bulb and the detailed body movements when throwing a baseball.

While SMV is widely appreciated because it maintains high fidelity and detail relative to the original actions being recorded, specialized ways of seeing need to be developed in order for SMV to actually be useful. Professional disciplinary communities are sometimes noted for their ability to coordinate visual artifacts in very particular ways as part of their work (Stevens & Hall, 1998), and researchers have developed various terminology, such as "professional vision" (Goodwin, 1994) and "noticing" (Sherin & van Es, 2005), to describe how professionals develop selective perceptions of specific situations. Such research suggests that for students to be able to productively work with SMV, they must also learn to see and notice aspects of the video in particular ways. This study reports on a classroom design experiment around the topics of movement and animation and asks how students discuss and make sense of SMV.

Designed Unit and Data Sources

The design experiment took place at a public charter elementary school in the United States Intermountain West as an extension to other work we have done with elementary students examining data related to the human body (Lee & Thomas, 2011). Fifteen fifth grade students from two classrooms participated in the unit. Over 13 days, the students met one to two times per week to examine and discuss SMV footage of a bouncing ball, a vertical jump, and other idiosyncratic bodily movements that they performed. Following the SMV discussions, students modeled the movements as they noticed them using stop motion animation software (SAM Animation, Searle, Gravel, & Rodgers, 2009).

All lessons in the unit were video-recorded. Whole-class discussions of SMV comprise the focus of this poster. In this poster, we report on the conversations and actions related to SMV of a vertical jump, which covered approximately two hours across three days.

As an assessment for the unit, students created flipbooks showing a realistic jumping motion at the beginning and end of the unit. These flipbooks also served as an initial object for class discussion and to help orient the students to the theme of animation. Researchers scored the flipbooks using a rubric that included epistemic fidelity, consistency, and conventionality of students' drawn representations.

Findings and Discussion

The students engaged with the SMV in several ways. Two of the most prominent ways were physically re-enacting the depicted motions and comparing jumps across types and students. Students used physical re-enactments to supplement their explanations in front of the class. During one discussion after watching video of a student's jump, students noted that one of the jumper's arms moved upward. However, there was disagreement about which arm it was; one student stood up, oriented himself in the same way as the jumper in the video, and then moved his arm to demonstrate which arm he thought moved. In response, another student came to the front of the room to model the jumping motion while also adopting the same position and orientation as the jumper in the video (Figure 1). Soon, other students began to explore the movement themselves.

Figure 1. Students immediately re-enacting the slow-motion jump to determine how a jumper's arms were moving.

Students also engaged with the video by comparing across different students' jumps for both common and different movements. They chuckled at odd movements, and they also noted that those odd movements were idiosyncratic. By looking across multiple examples, the students were able to find commonalities across jumps, which they discussed further and used later in their stop motion animations.

These stop motion animation videos were of variable quality with some inconsistencies across groups with respect to what jump features were depicted. However, when the students' post-unit flipbooks for depictions of a horizontal jump were assessed, there was a significant improvement ($t=-3.68$, $df=12$, $p<.001$). Figure 2 illustrates changes in a student's pre-unit and post-unit flipbooks.

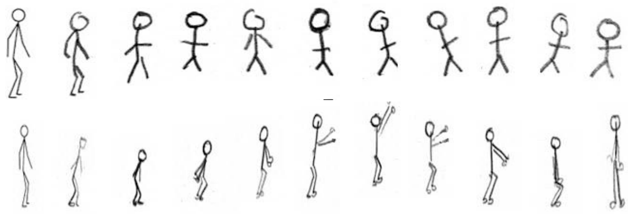

Figure 2. Excerpts from one student's flipbook before (top) and after the unit (bottom).

In light of these results, this initial effort seems to suggest that the use of slow motion video does have promise. The full range of strategies for making sense of such video still needs to be explored, but it appears that re-enacting motions viewed in slow motion and comparing multiple examples of the same phenomenon may be important ways for students to relate to and interpret information in this medium.

References

Goodwin, C. (1994). Professional vision. *American Anthropologist, 96*(3), 606-633.

Heck, A., & Uylings, P. (2010). In a hurry to work with high speed video at school?. *The Physics Teacher, 48*(3), 176-181.

Lee, V. R., & Thomas, J. M. (2011). Integrating physical activity data technologies into elementary school classrooms. *Educational Technology Research and Development, 59*(6), 865-884. doi: 10.1007/s11423-011-9210-9

Mazur, V., Krehbiel, P. R., & Shao, X. M. (1995). Correlated high-speed video and radio interferometric observations of a cloud-to-ground lightning flash. *Journal of Geophysical Research: Atmospheres (1984–2012), 100* (D12), 25731-25753.

Searl, E., Gravel, B. E., & Rogers, C. (2009). SAM Animation (Version 1.1). Tufts University, Medford, MA.

Sherin, M., & van Es, E. (2005). Using video to support teachers' ability to notice classroom interactions. *Journal of technology and teacher education*, *13*(3), 475-491.

Stevens, R., & Hall, R. (1998). Disciplined perception: Learning to see in technoscience. In M. Lampert & M. L. Blunk (Eds.), *Talking Mathematics in School: Studies of Teaching and Learning* (pp. 107-149). Cambridge: Cambridge University Press.

Acknowledgments

This work was funded by NSF grant DRL-1054280 and the Marriner S. Eccles Foundation. The opinions in this paper are those of the authors and not necessarily of any funding agency.