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***Research Spotlight***  
***Early Investments Initiative***

**Using 21<sup>st</sup>-century cameras to gather full-day/full-week streams of video in preschool classrooms with minimal disruption**

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As part of the Early Investments Initiative at the University of Illinois' Institute of Government and Public Affairs (IGPA), we piloted 21<sup>st</sup>-century video technology as an alternative to more traditional videotaping approaches. We collected full-day video streams by combining panoramic classroom recordings with close-up teacher focused recordings. This camera arrangement allowed us to approximate what classroom observers would see when seated in a classroom or an observation booth. The setup also allowed us to gather video across entire days and weeks in a feasible manner, because the equipment did not require a staff person to remain present in the classroom. In conducting this study, we were interested in questions such as:

- *Was this process logistically and economically feasible relative to traditional methods, such as using a handheld camera?*
- *Did the presence of camera equipment and microphones lead to only minor distractions and disruptions to students and teachers?*
- *Did the technology work consistently, with few technical problems and recordings that were crisp and clear?*

If these questions could be answered convincingly, we anticipated that our approach could help answer important questions about classroom observations where the presence of a person is limiting, including about inter-rater reliability and about fluctuations within and across days.

***Background Regarding Live and Video Observations***

In the past, live observation has been the standard mode of classroom observations. Yet, cost and logistical constraints often mean a single (or small number) of raters can observe a classroom, since sending many raters multiplies transportation and labor costs, quickly exceeds classroom space, and disrupts classroom practices (Casabianca, McCaffrey, Gitomer, Bell, Hamre, & Pianta, 2013; Cohen 2016; Goe, Bell, & Little, 2008; Weisburg et al., 2009). Although some university-based settings are equipped with observation labs, these are the exception rather than the rule. Alternatives to live observation are of increasing interest as the need for more numerous observations is prompted by accountability efforts and as technology has rapidly advanced. Current evidence does not strongly support one mode (live or video) over the other, yet comparative studies are relatively few in number and most video collection has relied upon single cameras, often handheld. Our project piloted a different approach that: (a) used multiple cameras to better approximate live observations and (b) did not require a staff person to remain present with the cameras.

## ***What We Did and Found, in a Nutshell***

The short answer to each of our focal questions was yes. On the whole, the approach was logistically and economically feasible, the cameras were not highly disruptive, and the technology generally worked as expected and provided codable video. With IRB approval, we gathered approximately 224 hours of video across nine classrooms at two different early childhood centers in Illinois. For the first eight classrooms, we recorded full days (from morning arrivals through nap time shortly after lunch) for a full week (Monday to Friday) in each classroom. For the ninth classroom, we recorded full days every Friday for 14 weeks, and we added audio recording of individual children's vocalizations and conversations. We had a team of a dozen faculty and students code about 425 15-minute segments from the video using the Classroom Assessment Scoring System (CLASS) Pre-K. For CLASS coding, we eliminated segments of time when the teacher and children were out of the classroom, or when both of the cameras malfunctioned. The video allowed us to conduct regular consensus meetings where the entire team of a dozen raters coded and discussed the same segments, and we also had subsets of coders rate the remaining cycles. As a result, we can add to the growing literature documenting considerable variation across raters and cycles. For instance, we found that raters consistently met the CLASS within-one threshold for reliability but had much lower exact agreement. Scores also fluctuated within and between days in relation to the type and content of activities. These findings reinforce the need to consider alternative training requirements and to consider scoring strategies beyond simple means across items and cycles. This would be particularly important when using the CLASS for high stakes accountability purposes.

## ***Details About Our Approach and Lessons Learned***

Although on the whole we found the remote video streaming approach with multiple cameras to be feasible and effective, we learned some valuable lessons that we are incorporating into a new project. These lessons may prove valuable for other researchers engaged in classroom observation and accountability assessments.

### ***Our Approach***

The video recording cameras that we used were the Swivl, with an iPad, and the V.360; the audio recorder was LENA. The Swivl allowed us to focus in on a particular area of the classroom where a teacher was leading a lesson, or where the students all gathered for a group activity. The V.360 captured a panoramic view of the entire classroom. This approximated what a live observer might see when moving back and forth between focusing on one activity and then panning the room. Although the camera audio – especially Swivl – allowed us to well capture what the teacher and nearby children said, LENA helped us understand the experiences of individual children.

We selected the latest versions of equipment available at the time of purchase. We used [LENA](#) Pro version v3.4.0 which included software, Digital Language Processor Kit, and two clothing items. We used the Gen2 [Swivl](#) Robot, which included a base for device mounting (the iPad) with infrared tracking capabilities of two microphone markers. The setup required a compatible iOS or Android device in order to install the free Swivl app software. In addition to the original Swivl order, we purchased a stand for the base in order to raise the system above obstructions. We used the [V.360](#) HD action camera kit, which included the HD camera, Bluetooth remote control, battery, charger, and case. In order to mount the V.360 high enough to capture the entire classroom, we purchased a clamp mounting system.

Each device could be turned on and left for an entire day. At the end of the day, a staff person returned to collect the devices for data uploading. In terms of classroom setup, for the V.360, we searched the rooms to locate a tall shelf or cabinet on which to securely clip the camera. A higher mounting point enabled the best capture of panoramic footage and was out of children's reach. The Swivl base needed to be lower in order to capture close-up video. A lower shelf in a corner, near to where the class gathered for large group was the goal. Since Swivl was at a reachable height for most children, it helped to put something secure in front of the base to avoid the equipment being knocked over. Before deciding on final placements of the cameras, we located available outlets that wouldn't require too many extension cords. We ran the

extension cords along the wall in as non-conspicuous a manner as possible, and taped the cords with blue painter's tape to prevent pulling or tripping. For LENA, a child wears a vest with the recording device placed in a pocket. Teachers assisted children in putting on the vest each day.

We initiated these practices in an early child education center that was accustomed to regularly having researchers engaged with their classrooms. We then added a center that was receptive to research, but was less often engaged, finding the approach was feasible in both contexts.

### ***Lessons Learned Related to Cost and Logistics***

We had a limited budget with internal seed funds, which steered us toward a more pragmatic “build your own” approach to purchasing and adapting technologies rather than a “pay for complete” approach.

Under the direction of a graduate-student project coordinator, undergraduate students helped set up and take down the cameras and process the video. A local videography expert offered us technical support without charge. The “build your own” approach meant that our team needed problem solvers who were detail oriented, undaunted by technical problems, ready to think on their feet, and willing to reach out for help when needed. We created step-by-step instruction manuals, with snapshot pictures next to text, to help guide team members when they were setting up and taking down the cameras and when they were processing the results. One of the greatest logistical challenges we faced was disk space for the very large video files. We were lucky to have access to our university's secure server, which enabled us to dynamically increase our core and backup space as our needs expanded. Another logistical challenge was being sure we had staff to turn on cameras at the beginning of each day and pick them up at the end of each day. By hiring multiple undergraduate students and working with nearby centers, this was feasible. However, for wider scale adoption of this technology and larger projects, other strategies would be needed (e.g., training center staff to turn on and off cameras and switch video cards daily).

Choosing between a “build your own” and “pay for complete” system will continue to be an important decision for future projects, requiring continual re-evaluation as technology is constantly evolving. We found that being able to demo equipment and visits with prior users were quite valuable, as was thinking through total costs and data accessibility. For instance, we initially considered a different camera setup, but the cameras we ended up using – Swivl and V.360 – became available as we were testing equipment. These cameras were smaller and more durable than the originally-planned device, making them better suited for early childhood classrooms. For our next project, we again re-evaluated current options. Swivl now has the capability to record multiple independent video and audio channels, as well as securely host and store data on [Swivl Cloud](#). Another option, Observer XT by [Noldus](#), combines a powerful cloud-based professional software and storage package with pre-built and customized multi-camera packages, but is more expensive. A tradeoff of these cloud-based systems relative to university servers is that users have less control of their data (i.e., someone else is storing your video) meaning it is important to carefully consider access (will you have long-term access without storage or upgrade fees?) and privacy (clearing through IRB and considering personal ethics). Although both of these systems have higher direct costs than a “build your own” system, the latter can have additional labor costs (video processing, software setup, server storage) and support needs (local technical expertise).

### ***Lessons Learned Related to Disruptiveness***

Overwhelmingly, teachers reported that the cameras and recordings were not distracting to their teaching or for their students. The Bluetooth microphone tracker for the Swivl was on a lanyard that teachers wore around their necks. Occasionally, a student would notice the lanyard, however questions were generally infrequent and easily answered with minimal disruptions. Most teachers naturally explained the systems to students when the project began, and providing a script for teachers to adapt is a helpful way to ensure a smooth start. Teachers also commented that when they were videotaped previously, other types of cameras requiring a large tripod proved far more disruptive. What was essential for our system was being able to identify locations where the two cameras could either be clipped from or mounted on a shelf. And, we needed to find ways to tape extension cords out of the way. We found that a pre-visit to scope out the classroom

helped us to identify ideal locations in advance and to come prepared with the right number and lengths of cords (and plenty of tape). We also interviewed each teacher three times – once before, once immediately after, and once several weeks after we videotaped. The first interview was especially helpful for establishing rapport and for learning about prior experiences with videotaping. The post interviews helped us learn lessons to implement in future classrooms.

### ***Lessons Learned Related to Technical Problems***

Technical problems did come up throughout our project, but when approached with a problem-solving attitude none derailed our larger goals. One of the greatest challenges we had early on was with the Swivl's capabilities for following the teacher as she moved about the classroom. The tracking relies on an infrared signal in the special microphone worn by the teacher. When the signal is broken, Swivl can get "lost" in trying to track the teacher. We found this happened with all the comings and goings in the early childhood classrooms, and, after our first weeks of recording, decided to forgo tracking and focus the Swivl on frequently used areas of the classroom (e.g., circle time and snack/centers tables). More recent technological improvements to Swivl help circumvent this problem. Another early technical problem involved trying to rely on a long-lasting battery for the V.360, which we hoped would avoid needing to plug into wall outlets. The recommended battery was incompatible, and we were lucky that we had purchased two V.360's when the battery blew out the first camera the day before our first recording. The company replaced the damaged unit, and we figured out the logistics of using extension cords. These examples demonstrate the broader lesson that technical problems are unavoidable when using such technology (even live recording, where equipment may malfunction or user errors can occur, such as forgetting to take the cap off the camera lens). In short, even the best laid plans cannot anticipate all that can happen in the dynamic environment of preschool classrooms, with varying heights of students and teachers, different centers distributed throughout, teachers that move around a lot, different obstructions that make no camera location perfect, etc. But, we found that technical problems were relatively rare, and generally surmountable with creative problem solving.

### ***Next Directions***

We see many future exciting directions for using multiple cameras and microphones that can record full days and weeks in early childhood classrooms, providing deeper insights into variability of experiences, activities, and practices than can be obtained by a single visitor or a handheld camera. Although thus far we focused on using the video to examine one coding system, the CLASS PreK, the one-time investment in video collection opens the door to payoffs through many different uses. We could, for instance, readily code the video with other systems and versions, such as the ECERS-R and ECERS-3, which would allow us to compare the two versions to each other, and to the CLASS. The video approach can also be paired with live coders to continue to build evidence related to how codes based on each approach compare. Segments can further be re-watched to probe findings, such as when raters are less reliable or scores are less correlated within or between coding systems. The video can also be used with other types of coding systems, such as rating particular behaviors and contingent reactions.

Where desired, coders can be allowed to pause, go back, and zoom in on teacher-student interactions, as well as view and attend to many different areas of the classroom. And, as our pilot of LENA vests demonstrates, experiences of individual children in classrooms can be compared to the average experiences of the average child. Another future direction would be outside recording, taking advantage of the ways in which cameras like the V.360 are designed for outdoor usage. Although we focused on activities inside the classroom, we found that for a sizable fraction of time the children were on the playground. Outdoor cameras would allow the coding of such activities, as in systems like the ECERS, and would more broadly facilitate research into this important setting for unstructured adult and peer interactions.

We hope that our sharing our experiences using new technologies in early childhood classrooms encourages others to explore some of this potential.