Teacher Candidates Working with Digital Technologies to Support Multilingual Students in Asset-Based Ways

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Abstract: This article demonstrates how the digital technologies of video recordings and webcams in a virtual learning after school program made it possible for teacher candidates to practice and reflect on asset-based pedagogies for multilingual students. Implications to engage teacher candidates in asset-based pedagogies in virtual science and engineering programming are discussed. The authors invite teacher educators to consider how the potentials of video recordings and webcams can be extended to other content areas and in-person teaching.

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Introduction

Even prior to the COVID-19 pandemic, P-12 multilingual students, children and students classified by the school district as "English Learners", were not consistently provided equitable, culturally sustaining learning practices in the classroom (Kleyn & García, 2019; López, 2017; Paris & Alim, 2014). The COVID-19 pandemic has exacerbated the inequities multilingual children face and has underscored the need for engaging, equitable learning opportunities. During the height of the COVID-19 pandemic, there was thus an enhanced need for teacher education programs to offer teacher candidates (TCs) high quality field experiences to practice supporting and engaging multilinguals. Responding to this need, during the 2020-2021 academic year, the authors pivoted toward virtual internships for TCs that were interdisciplinary and focused on language-integrated science and engineering practices.

With the assumption that virtual P-12 learning opportunities will continue to be prevalent (Singer, 2021), we asked, "*How do virtual teaching interactions afford opportunities for TCs to foster asset-based pedagogies* (López, 2017; Paris & Alim, 2014*) with multilingual students through science and engineering practices?*" Our analysis revealed how digital technologies (e.g., webcams and video recordings) made it possible for TCs to enhance communication and social connections with multilingual students through movement, video images, and working with materials (Kress, 2010; Lemke, 2004), as well as facilitate reflective teaching practices (Gibbons & Farley, 2021). Through webcams and video recordings, we found that TCs were enacting and reflecting on equitable learning opportunities for multilingual students throughout their virtual internship.

Conceptual Framework

Prior to the recent need for P-12 teachers to teach virtually given the COVID-19 pandemic, a call for teacher education programs to prepare TCs to teach online had been established. While the number of online learning opportunities for P-12 students was growing, it was without proportionate teacher preparation for teaching in an online environment (Kennedy & Archambault, 2012). Additionally, there was concern that teacher education programs tended to give more value to in-person clinical experiences despite a growing trend toward virtual and hybrid P-12 learning (Larson & Archambault, 2019).

Preparing TCs to differentiate content and advocate for multilinguals who are learning English in a virtual space requires additional considerations. Multilingual students learning English must be provided with learning experiences in which they can engage and express through multiple modes in addition to words (Wright, 2015). At the same time, there is concern that virtual teaching and online clinical experiences may constrain such ways of engaging since teachers and students are physically separate and unable to work collectively with the same materials. An additional concern that has garnered attention during online learning in response to the COVID-19 pandemic is that many multilingual students and their families have unequal access to a high-speed internet connection, hardware, and materials required for digital learning (Ferren, 2021; Zehler et al., 2019). These digital infrastructure challenges may also be similarly experienced by TCs (Howell et al., 2021). Although pedagogical and infrastructure concerns can present a significant hurdle for equitable digital learning and teaching, we argue that there are indeed overlooked possibilities, such as facilitating the ability to reflect on asset-

based pedagogies and preparing TCs to cultivate equitable learning opportunities for multilingual students.

Our stance is that for TCs to support multilingual students learning English in science and engineering practices, their pedagogies must be culturally sustaining (Paris & Alim, 2014). That is, TCs must develop asset-based pedagogies, which see "students' culture as a strength, countering the more widespread view that inordinate achievement disparities stem from deficiencies in the child and/or child's culture" (López, 2017, p. 193). This requires TCs to flexibly orient to students' dynamic funds of knowledge (Moll et al., 1992). They must also create spaces for students to draw on their existing and evolving semiotic resources to express their thinking and knowing by hybridly mixing gestures, images, and working with materials in tandem with multilingual talk and writing (Canagarajah, 2013; García & Kleifgen, 2020).

For both TCs and students, considerations for teaching science and engineering virtually are distinct from other content areas. For one, science sensemaking (Lee et al., 2013), the material and visual-oriented communication of science practices (Lemke, 2004), and the uniqueness of communication in digital interactions (Androutsopoulos, 2021) provide expansive discourse opportunities for multilingual students to share their understandings of the natural and designed world that are not historically privileged in schools (Haverly et al., 2020). Through such complex ways of communicating in a virtual science and engineering space, a fertile ground for advancing equity pedagogies for TCs is created as they begin to know the multilingual students they interact with, learning more about *what* they know and can do, as well as *how* they come to know in expanded ways. Furthermore, because TCs have less formal training in science and engineering teaching (Cunningham et al., 2014), not to mention the linguistic practices of science and engineering (Shaw et al., 2014), if positioned from an asset orientation, this sentiment of 'not knowing' can create a space of curiosity and exploration where TCs may be more open to pedagogical inquiry. We show how in this virtual science and engineering teaching and learning space, webcams and video recordings became the means by which multilingual students shared their different ways of knowing and TCs practiced equity pedagogies.

Methodology

Context and Program Description

The virtual internship was situated within an interdisciplinary professional development partnership that had brought together stakeholders from a university, a community center after-school program, and a school district in a Mid-Atlantic state for the past five years. The data for this study comes from a 10-week virtual internship offered to TCs in the university's college of education.

The goals of the internship were two-fold: 1) provide the students in a partnering after-school program at a community center with equitable science and engineering experiences, and 2) provide TCs with an opportunity to foster relationships with students and develop asset-based pedagogies that draw on the myriad of multilingual students' cultural and linguistic knowledge. The students in the after-school program were in grades two through six and attended various nearby public schools. They were multilingual students who were part of a predominantly English/Spanish bilingual community that has faced political upheaval after a demographic shift resulted in Dominican and Puerto Rican communities

now representing the majority. All TCs had differing linguistic backgrounds from the students they taught, with the majority being English-dominant. The TCs were divided into two cohorts of 13 TCs with 12 students each. Teacher candidate cohorts met with their respective teacher educator on a weekly basis to plan, prepare, and reflect on each week's lesson.

In both cohorts, TCs led students through the engineering design process of investigations that positioned students as creative engineers who designed, refined, tested, and manipulated various products using everyday materials. In Cohort A, they explored circuits and motors, and in Cohort B, they explored early coding through the use of a BBC "micro:bit", an exposed circuit board that pairs with an easy-to-use website to introduce block coding to beginners (The Micro:bit Educational Foundation, n.d.).

Data Collection and Analysis

This study employs case study methodology (Merriam, 1998). The case is bounded by the two cohorts of TCs participating in a 10-week online internship. Data include artifacts from weekly hour-long co-planning meetings and co-teaching sessions for each cohort over the course of the internship. Data from co-planning meetings include lesson plans, meeting agendas, other shared documents/resources, weekly written reflections, and video recordings of co-planning meetings and corresponding transcripts and chat logs. Data from co-teaching sessions include video and transcriptions of weekly co-teaching between TCs and students in the after-school program. This included video from the main room and "breakout rooms" (approximately 4-5 breakout rooms each week per cohort). Finally, exit interviews for all participating TCs were a source of data triangulation. For one TC, her verbal reflections delivered as part of a conference presentation where she spoke about her teaching experience in the virtual internship were additionally included as part of the data.

Data analysis began with an initial open coding of interactional moments across the data that broadly addressed one of the two main concepts guiding the study's inquiry: use of technology and evidence of the development of or attention to asset-based pedagogies. Some interactional moments were sought out based on what TCs shared in the exit interviews while others were found in re-watching the video and reading transcripts. Video analysis was more heavily relied on over transcript analysis because of the visual nature of the inquiry. After identifying interaction moments, additional, iterative cycles of analysis were conducted to move between content-coding and focused coding of the data. What resulted from the analysis was repeated use of webcams in a way that we had previously not seen theorized and the repeated use of co-teaching video for TCs to reflect upon.

Findings

By working with webcams and video recordings, TCs practiced asset-based pedagogies and fostered equitable communication and social connections supporting multilingual students in the digital teaching environment. First, we focus on how webcams created possibilities for TCs to make space for students to have choices about their learning, how they display their learning processes, and expand their ways of sharing their ideas in virtual science and engineering interactions. Webcams also created ways for TCs and students to facilitate social connections. Subsequently, we consider how the plentiful, high-quality video made possible by the webcams, served as rich material for TCs to reflect on teaching

interactions to promote asset-based pedagogies.

Equitable Possibilities Through Working with Webcams

During the COVID-19 pandemic, learning incorporating webcams became a controversial topic, suggesting that requiring teachers, students, and TCs to use a webcam when online risked serving as a discriminatory practice of surveillance (Will, 2020), particularly when students' home practices and/or environment are not valued by the educational institution, teachers, or peers. In this study, however, the students TCs worked with were all physically located at an after-school community center, minimizing the concern about revealing one's home environment to others. Furthermore, there were intentional conversations about webcam use as a form of surveillance with TCs drawing on their current lived realities of also being students taking online classes.

Across the fields of language learning and early childhood education, webcams are impactful for multilingual learning interactions (Guichon & Cohen, 2014; Magnusson, 2021; Waldmann & Sullivan, 2019) primarily because they allow *students* to communicate visually, showing an object or indicating an idea with the camera rather than communicating with words. However, little is known about how *TCs'* pedagogies and interactions with students are influenced by webcams, and how *TCs* might also engage with such visual communication. In our analysis, we found that webcams changed ways of teaching for TCs, providing ways of promoting more equitable teaching and learning interactions.

With in-person video recordings of classrooms, video is often restricted to a camera positioned by an adult teacher or researcher rather than by students. In contrast, by removing and repositioning the angle of the external webcams that rested on top of each computer at the after-school center, students were able to show TCs multiple angles and perspectives of their designing and learning processes. For example, when students moved the camera downward to focus on their hands and materials as they built, TCs were able to view a zoomed-in play-by-play of students' design process. This perspective, often less visible in an in-person classroom, allowed us as teacher educators to foreground in our conversations with TCs the significance of the engineering design process rather than the final product that students created. Additionally, students could manipulate the webcam to choose what to show, or what *not* to show to create suspense, thus providing students a larger stake in how each learning interaction could unfold. For TCs negotiating their new roles as teachers in the classroom, such interactions emphasized the importance of a teacher as a cultivator, working *with* students and the material characteristics of technology rather than managing/controlling students, objects, and/or phenomenon. Lastly, in learning with webcams, TCs and students frequently held up materials to the camera and performed gestures in conjunction with and in lieu of words (Bose et al., 2021). This visual sharing made possible by the webcams provided opportunities for multimodal teaching and expanded options for communication between students and TCs beyond the spoken and written words, which was critical given TCs' and students' different linguistic backgrounds.

To illustrate these findings, we offer an example from week seven when a TC worked with two students in a breakout room to build a motor-based car. Despite the moment being virtual, it was defined by multimodality, being movement-oriented and tactile (Kress, 2010). As described by the TC, students could, "get into it, get on the ground, even though we're over Zoom". Throughout

the hour-long session, both the TC and students could be seen holding up the components of their design to the webcam at various stages of building. In doing so, TCs and students visually communicated information about their designs in conjunction with and in lieu of spoken words.

At one point, rather than holding up materials at eye-level, one student moved his webcam to face downward so that the TC and his peers could see his hands and materials while he was building rather than the previous moment when his face was positioned at the center of the screen. This move made it possible for the TC to carefully notice the process of the students' car building that would later inform the final design. A few minutes later, both students moved their webcams, this time pointing the camera toward the floor to show the TC their designed cars racing on the carpet. When reflecting on this moment, the TC noted, "the students were able to manipulate the camera, which ultimately invited me to experience and observe the moment with them. Being able to observe this process with them brought me into their perspective even thought I was through the screen." Although virtual, the TC felt that by moving the camera, the students could "really make sure like we were included because they [students] could have just said…like it (the car) ran … NO! they were like— 'look, like look what you helped me make.'"

In addition to including the webcam in ways that gave students choices, to the TC, the webcam was a way to build social connections between herself and students such that she perceived being included and being acknowledged as part of making the car. The TC and others in her cohort shared the concern that they felt uneasy about forming social connections with the students because they were virtual and felt that human relationships in the virtual setting felt "less personal" (as shared in an interview). Yet, the TC felt that she and her students were indeed able to connect through the invitation the students made through the camera. She theorized that the multilingual students she worked with were perhaps less comfortable and/or confident with connecting with her through spoken English, and thus believed they reciprocated and responded to her interest in them and their process of making through their visual invitation with the webcam and by allowing her to "participate" in the testing of the car (virtually). The TC suggested students made a social connection not by talking, which she reported was her means of developing a relationship of care, but by moving the camera lens. To the TC, if the webcams had remained stationary without the students moving them, she would not be able to see the action happening on the floor of the community center and would have been unable to participate with them at this critical moment.

Curated Teaching Videos for Teacher Candidates' Reflective Practice Toward Asset-Based Pedagogies

The beneficial uses of video of teaching practice as a source of reflection during clinical experiences are not new (Baecher et al., 2014; Gibbons & Farley, 2020). However, for many TCs, watching classroom videos can be daunting; there is a lot to process at one time, and they do not always have specific lenses to focus their attention. This process is further compromised by, in our experiences as teacher educators, low-quality audio captured in in-person classrooms with young students given movement and background noise, as well as recordings that may be focused on pre-determined moments of formal instruction, resulting in missed opportunities.

The digital space created a quantity and quality of teaching video that allowed for robust possibilities for TC reflection toward

developing asset-based pedagogies. Regarding quantity, the large volume of recordings from the virtual context provided TCs with a readily available, sizable library of video and still images to analyze. TCs had access to all the recordings, including video from breakout rooms they were not part of, to which they were able to refer. Moreover, the quantity of video provided a wider range of video for the authors, as teacher educators, to use in guiding TCs' reflection during co-planning meetings. This volume and range of video included what might seem like mundane or taken-for-granted interactions that are not typically recorded by TCs, their mentor teachers, or their university supervisors. Additionally, because students were wearing headsets with microphones, high-quality audio of student's voices was captured. Without this audio, students' words and ideas would not have been able to be recorded so completely, a critical component to what made co-planning sessions successful, as explored in the example below.

In co-planning sessions, transcript elicitation coupled with extensive recorded video created more in-depth, nuanced opportunities for formative assessment of TCs' pedagogical moves leading to shifts in asset-based pedagogies. In week five, some of the TCs had the opportunity to meet with students individually to check-in on the progress of their current design. An excerpt from three brief conversations between three TCs and three elementary-aged multilingual students during these meetings were selected for discussion the next week. These conversations were selected because nearly all the TCs' initiating questions were close-ended questions and mirrored the limited, yet often-default school discourse structure – IRE (teacher *initiates*, student *responds*, teacher *evaluates*) (Cazden, 2001). The types of initiating questions asked to one multilingual child included: "*Can we see your microbit? Did you put your code into it? Do you need help with anything? You're pretty good at this; do you like building? Do you want to be an engineer when you grow up?* and *What would you make?"* As a result, the multilingual students were limited to giving short, one-word or yes/no responses.

When the transcript was brought into the co-planning session, the TCs spent time in breakout rooms participating in a modified "notice and wonder" activity (Zembal-Saul et al., 2013) eliciting TCs' understandings on what they observed from the conversation. TCs' responses indicated that they noticed the short utterances through comments like "he replied 'no' a lot; she responds with 'yeah' a lot; he seems to give short answers and does not explain beyond what is directly asked; her responses got longer as the conversation went on." Then TCs "wondered" (i.e., posed meaningful questions about the transcript) in their breakout rooms. They wondered whether the students were just shy, if they understood the questions, or if there was a "language barrier." As evident in these wonderings, the TCs were not yet reflecting in an asset-based way.

When shifting from their breakout rooms to the whole group, the teacher educator used the TCs' "noticings" from their "notice and wonder" activity to highlight the linguistic structure of the questions being asked. TCs were ultimately able to see how their method of question-asking restricted the students' responses, providing space for TCs to critique their initial deficit framing of students' ways of responding.

Furthermore, during the conversation, one TC referenced the current transcript and a previous breakout room video to further develop asset-based pedagogies. She noted, "At one point when [other TCs] asked 'oh, do you think you'd want to be an engineer when you're older?' and [the child's] like 'yeah,' and they were like 'what would you make?' and [the child] said 'bunnies.'" While her colleagues had been puzzled by "bunnies" as

an answer, the TC referenced breakout room video she had watched during previous week to suggest that the child's response of "bunnies" was not a misunderstanding of the question. Rather, because of the unrestricted access she had to extensive video from her and other groups' breakout rooms across multiple weeks, she understood that when the child said "bunnies," he was referencing the combination of multiple events from prior weeks. Based on video analysis over time, the TC was able to exemplify how TCs can have a more nuanced interpretation of a child's response and not dismiss the "bunnies" response as a misunderstanding or attributing the response to the perception of limited English-speaking abilities.

The focused video and transcript noticing of co-teaching moments provided the opportunity for TCs to recognize changes they wanted to make to their own practice to better support multilingual students while also recommending changes their fellow TCs might want to consider. In a second illustration from a co-planning meeting, while watching video that included the practice of taking attendance from other TCs' breakout room, one TC expressed the concern that the approach was awkward and confusing. She suggested that instead of the TCs reading the students' names aloud continuously and asking students to confirm/correct the pronunciation, "that maybe to avoid calling the students the wrong names in the beginning, instead of being 'is your name Demerius,' we just go around and say our names. Like avoid saying- or calling them by- the wrong names." She later enacted this practice in her own breakout room. While this suggestion could be perceived as a very minor shift, it demonstrated the TC's ability to imagine, suggest, and ultimately enact a more culturally sustaining practice of honoring students' names (Kohli & Solórzano, 2012), a practice propelled by video she was not part of but able to watch and reflect on. Further, because taking attendance could be overlooked as an inconsequential interactional moment in the classroom, this moment might not have been captured on video in a traditional, in-person teaching placement. Although TCs wrote weekly reflections, it was in the conversations around the videos and transcripts that incrementally showed the TCs' emerging and shifting of beliefs and practices for more equitably supporting multilingual students.

Conclusion

The potential of virtual teaching has been historically overlooked in favor of in-person instruction (Larson & Archambault, 2019). Yet, we are suggesting two characteristics prevalent with virtual teaching, webcams, and video recordings, can invite opportunities to provide equitable, culturally sustaining learning opportunities for multilingual learners. One pedagogical possibility realized through virtual teaching is how the visual and moveable nature of external webcams was critical for students and TCs of different linguistic backgrounds and experiences to build relationships and communicate. While webcams can pose a threat to equitable teaching through monitoring and control (Will, 2020), we show more equitable possibilities of webcam use when students are given a choice as to how and when to bring webcams into their learning interactions.

Similar to previous scholarship, our findings suggest the material characteristics of webcams impact the process of learning in a multilingual environment (Waldmann & Sullivan, 2019). Extending this work, the current study suggests webcams impact learning interactions between TCs and students, not only by permitting the visual presence of a teacher and student (Guichon & Cohen, 2014), but by students revealing to

TCs their perspectives about their learning as they position, turn the webcam on/off, and work with materials. Doing so provided TCs with insights (based on evidence beyond words) as to what students know and can do. By recognizing multiple ways of communicating and expressing ideas, TCs see the multiple assets that students bring to the interactions rather than fixating on perceived deficits. We further suggest that webcams provided students multiple avenues for choice that altered the positioning of the TCs in the interactions to be on more equal footing. All of these phenomena additionally provided possibilities for social connections between TCs and students from different linguistic and cultural backgrounds.

Furthermore, the quantity and quality of video data provided TCs a more complete picture of their interactions during the sessions and the ways in which they interacted with students. Data captured via online digital technologies allowed for TCs to collectively reflect on detailed interactions of targeted moments across time leading to more evidence-based explanations/insights into the interactions. As one TC summarized, "collectively, in planning, we figure out something." This collective figuring out served as a powerful form of formative assessment of the TCs' development of asset-based pedagogies towards multilingual students each week and additionally highlights the need for focused analysis of teaching video in traditional, in-person coursework. One way this might be achieved is to reconceptualize how video analysis occurs. For example, if several TCs have video of a read-aloud, they could collectively watch their videos of read-alouds over time with a fine-grained analysis of their interactions with multilingual students to discuss where they see culturally sustaining practices with support from a teacher educator. Additionally, seemingly inconsequential moments could be the focus of analysis, like viewing videos from multiple rooms of students lining or setting up, transitioning, etc. (In)equity is always present and always relevant; by integrating equity talk in all reflections on teaching, not as an "add-on," (Dyches & Boyd, 2017) TCs can see students' assets and see more opportunities to engage in culturally sustaining pedagogies in all aspects of the day.

To conclude, though separated physically, the digital technologies of webcams and video recordings during a virtual science and engineering internship with multilingual students and TCs created possibilities for previously overlooked and new ways of learning together – be it TCs and students engaging in a shared, iterative process of engineering design and re-design or TCs collaboratively reflecting on each other's breakout room videos. We suggest that these synergistic possibilities brought together between webcams and video recordings in a virtual science and engineering space may also offer opportunities to engage TCs in equity pedagogies in *other* content areas in addition to in-person teaching.

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