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Mary D. Burbank
University of Utah, mary.burbank@utah.edu

Melissa M. Goldsmith
University of Utah, mmg7@utah.edu

Alisa J. Bates
University of Western States, ajbates3@gmail.com

Jennifer Spikner
Montessori Academy of Chicago, jspikner@montessoriacademychicago.org

Koeun Park
University of Utah, koeun.park@utah.edu

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Empirical Research

Teacher Observations Using Telepresence Robots: Benefits and Challenges for Strengthening Evaluations

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Mary D. Burbank[1], Melissa M. Goldsmith[1], Alisa Bates[2], Jennifer Spikner[3], and Koeun Park[1]

Abstract

Project SCOUT (School Classroom Observations Using Telepresence) details findings from a pilot project where observers used a telepresence robot designed to capture teaching episodes. The study examined: 1) participants' ability to review classroom teaching and determine teaching quality using a telepresence format; 2) whether a telepresence robot allowed observers to review the specific teaching competencies they would otherwise evaluate during in-person observations; and 3) the success of the telepresence robot in evaluating specific pedagogical environments (i.e., Montessori classrooms). Survey and observation data from two focal classrooms highlight the benefits of telepresence tools by allowing flexibility and the potential for a wider audience of observers using real time data collection. Limitations of a telepresence robot include challenges in its ability to capture classroom nuances necessary for evaluation, coaching, or supervisory support. Those who use a telepresence robot must be particularly sensitive to using a technology that might cause privacy and safety concerns for children and their families, particularly for marginalized communities.

Keywords

telepresence supervision; educational evaluations; teacher observations

[1] University of Utah, Salt Lake City, Utah, USA
[2] University of Western States
[3] Montessori Academy of Chicago

Corresponding Author:
Mary D. Burbank (College of Education, University of Utah, 201 Presidents Circle, Salt Lake City, UT, 84112)
email: mary.burbank@utah.edu

Introduction

Project SCOUT (School Classroom Observations Using Telepresence) details findings from a pilot project where observers used a telepresence robot designed to capture teaching episodes. The telepresence robot provided remote observers with the opportunity to view teaching in two preschool-aged Montessori classrooms in a Title I public school. This research examined observers' general viewpoints of the robotic tool as a way of evaluating teaching. The project description, survey data, and observation ratings and comments highlight the strengths and limitations of a telepresence robot as a tool for evaluation within the context of classroom settings. The study examined: 1) participants' ability to observe classroom teaching and determine teaching quality using a telepresence format; 2) whether a telepresence robot allowed observers to examine the specific teaching competencies they would otherwise evaluate during in-person observations; and 3) the success of the telepresence robot in evaluating specific pedagogical environments (i.e., Montessori classrooms). The benefits of telepresence tools allow for flexibility and the potential for a wider audience of observers using real-time data collection. Limitations of a telepresence robot include challenges in its ability to capture classroom nuances necessary for evaluation, coaching, or supervisory support. Those who use a telepresence robot must be particularly sensitive to using a technology that might cause privacy and safety concerns for children and their families, particularly for marginalized communities.

Literature Review

Measures of teaching quality typically require evaluations of teaching with the understanding that the expectations for quality remain constant over the course of educators' careers. Typical measures of teacher quality range from standardized measures of student performance in K-12 classrooms to performance assessments of teaching within the contexts of their daily work. In general, standard methods of teaching observations take place during face-to-face engagement between teachers and supervisors, administrators, coaches, or mentors (Slick, 1997; Donaldson & Papay, 2015). The information-sharing formats of these experiences are relatively similar, though the goals differ depending upon the intentions of the observations and the relationship between the observer and those observed. For example, coaching includes a stance that is quite different from the evaluative role of an administrator (Farver & Holt, 2015; Snyder et al., 2015). Suffice it to say, how quality teaching is identified and documented has evolved over time and can be developed through a unique perspective using a telepresence tool.

Profiles of teaching competencies capture a range of formats thereby allowing for flexibility in data gathering. Both formal and informal measures for data gathering are possible with the understanding that evidence of quality must include valid and reliable performance demonstrations (Wei & Pechone, 2010). Given the pervasive presence of virtual classroom environments, teaching practices have never been more reliant on the role of technology in the delivery and evaluation of quality instruction and student learning.

Contemporary measures that include performance assessments typically allow teachers to demonstrate proficiencies through document submissions and videos designed to illustrate teaching competencies (Coggshall et al., 2008; Darling-Hammond & Snyder, 2000; Florell,

2016). As a measure of teaching quality, performance assessments provide opportunities to review teaching through authentic demonstrations of competencies.

Telepresence Robots and Observations

A telepresence robot is a contemporary tool that allows for off-site observations of teaching episodes. Telepresence observations use a video camera on wheels to permit movement around the classroom. It transmits real-time classroom activities through live video and audio feeds to observers. The use of a telepresence robot within observation experiences represents an innovation to support and evaluate teachers' work (Fischer et al., 2019; Fischer et al., 2018). Robot implementation creates opportunities for flexibility and efficiencies in accessing classrooms and increases the potential for a wider audience of observers using real-time data collection.

The tool's use often appears within settings for individuals with disabilities as part of special education teacher training or based upon the needs of individuals (Fischer et al., 2018; Michaud et al., 2007). Additionally, past research has unearthed the merits and limitations of operational dimensions of various tools that enhance experiences (e.g., sound, video, costs, and quality of feedback) (Schmidt et al., 2015; Soffar, 2019). These benefits have served a range of communities, including rural communities.

To be effective, however, observers must consider multiple variables when integrating this tool into the classrooms where they evaluate teaching episodes. For educators, the use of telepresence robots for observation presents a unique set of opportunities and challenges (Bagley & Shaffert, 2015; Gareis & Nussbaum-Beach, 2008). Telepresence robots provide an opportunity for real-time exposure to classroom teaching. Further, the affordances of a robot allow for in-depth attention to teaching nuances such as the movement of teachers and students around the classroom, zeroing in on specific elements of teaching rather than the classroom as a whole, and portability. Positively, technological support has the potential to access teaching demonstrations across settings and over time thereby providing vantage points for pinpointing teaching practices in ways that are in-depth and specific. Practically, a telepresence affords observers efficiencies and an increased ease in visiting a range of classrooms over time and across settings. These are obvious benefits and speak to contemporary trends using technology integration.

As is the case in all observations, a challenge in using the telepresence robot is ensuring that reviews of quality within these observations facilitate comprehensive discussions of teaching quality based in agreed-upon expectations. Equipment costs and a site facilitator to manage the telepresence must also be considered. Additionally, if educators are using a telepresence that allows for long-term storage and/or recording of classroom students, it also has the potential to infringe on student privacy (Duball, 2021; Sweeny, 2020). At issue, is how images of children are shared and stored and by whom. For example, the privacy of children who identify as undocumented may be at risk. Therefore, consideration must be given to safeguards on images and their use when implementing telepresence technology.

Observations in Montessori classrooms

In addition to geographic contexts of schools, each classroom brings its own culture, way of operating, and philosophical stance (Peterson & Deal, 2009; Barth, 2002). Within the context of Montessori classrooms, classroom teaching must include an environment where students work at their own pace, where teachers work directly with students through one-to-one and small group instruction and where an uninterrupted morning work cycle creates the space where teachers work with individuals while other children work independently with materials to practice previously learned material (Marshall, 2017). Because of the amount of independence and self-direction required within Montessori settings, students learn, over time, to navigate conflicts and problem solving in ways that are typically independent and without adult assistance. These components of independent work time and teacher attention to individuals are essential to the evaluation of teachers' work for teachers in Montessori settings.

Purpose

Project SCOUT details observers' perspectives on the virtual observation of Montessori classrooms, where students are 3-5 years of age. Telepresence observations used a synchronous video camera, which looks like an iPad on wheels. It captured live video and audio of the classroom for observers and moved around the classroom as the lesson unfolded under the direction of an onsite facilitator, who monitored that the technology was working. The telepresence did not have a recording or storage capability. A series of practice sessions provided the teachers and students with exposure to the telepresence robot before formal observations took place, where students learned why the telepresence robot would visit their classroom in the future. This multi-day process allowed classroom students, caregivers, and teachers to ask the onsite facilitator questions about the technology and its use. The students named the robot (i.e., "Penny") and understood that "Penny" was coming into their classroom to help teachers learn more about their classroom.

The observed teaching episodes took place in a diverse, Title I school, where a Montessori pedagogy was infused in the classrooms of two teachers working as part of a larger project. Our work within this community extends over five years and includes establishing a learning environment within a traditional public school setting with a curriculum and approach to teaching and learning typically afforded to children within more affluent communities. Our collaboration with the school's teachers and administration is part of a community-engagement partnership with a public school committed to ensuring quality teaching experiences for all children.

Project SCOUT examined three questions: 1) Did the telepresence format allow observers to assess general teaching quality?; 2) Did the telepresence robot allow observers to observe the particular teaching competencies they would evaluate during an in-person, traditional mode of observation?; and 3) How successful or unsuccessful was the telepresence robot in evaluating specific pedagogical environments (i.e., Montessori classrooms)? Evaluating the robot technology as part of Montessori classroom teaching offers a unique test of the capabilities of this tool for remote observation. Montessori instructional practices often include one-to-one interactions between teachers and students and permit multiple activities to be occurring

simultaneously within the classroom. Researchers were interested in whether the nuances of Montessori teaching would transmit effectively through the robot in a way that observers could evaluate the lessons.

Observers conducted their SCOUT observations virtually and were off-site from the focal classrooms. The virtual presence allowed education experts to determine whether, and in what ways, the robots could support multiple observers in their visits to Pine View Elementary (a pseudonym), our focal site. Project data illustrate the strengths and limitations of a telepresence robot within classroom settings and highlight the importance of observer expertise. Furthermore, the use of telepresence robots to evaluate teaching requires tools that minimize difficulties and an understanding that some evaluation criteria are more readily observed using the robot.

Research Design

As part of a 2018 pilot study linked to a larger research project, five observers completed a series of lesson observations in the classrooms of two Montessori teachers working in Pre-Kindergarten classrooms at Pine View Elementary, a Title I school. The school has a student population that is 78% students of color, 51% English Learners, and 88% enrolled in the free or reduced lunch program.

Two early childhood classrooms were transformed through physical, curricular, and pedagogical adjustments, so that these traditional early childhood classrooms became full Montessori educational settings. These efforts were part of a series of research projects designed to evaluate the classroom experiences of young children, the importance of collaboration, and the role of Montessori in supporting diverse learners.

The current study examined the role of lesson observations within the context of the unique Montessori pedagogical setting. The nuances of teaching, the role of curriculum, and the philosophical underpinnings that inform our setting prompted an investigation into observers' evaluations and the role of technology in these explorations. Pilot data shed light on the potential benefits and limitations of the robotic tool.

Participant Observers

Observers viewed the lessons through the telepresence robot, which captured lessons in a real-time, synchronous fashion. The observers included five teacher educators located across four sites in two states. One of the five observers viewed the lesson in-person. Observers' areas of expertise as teacher educators included generalists in K-12 preparation, early childhood education, and Montessori specialists. Observers had elementary and secondary supervisory experience, which encompassed observation and evaluation of teaching episodes. Observers' experience ranged from two to 40 years. Observers held administrative, faculty, and graduate student positions. All observers have at least "a little" experience observing teachers in Montessori classrooms. Because observers' lesson feedback is informed by individual experience, stance, and knowledge of teaching and learning, the observers represent a range of expertise due to varied backgrounds and perspectives on teaching quality (Bates & Burbank,

2019; Burbank et al., 2016a; Burbank et al., 2016b Wolff et al., 2014). Table 1 presents a summary of the participant observers' demographics.

Table 1

Observers' Expertise, Typical Supervision Assignment, Current Position in Education, and Evaluator Experience Level

Rater	Expertise	Typical Supervisory Assignment	Current Position	Evaluator Experience Level
A	K-12 Generalist	Elementary	Administrator	Experienced
B	Reading	Elementary	Faculty Supervisor	Experienced
C	Montessori Education	Varying	Head of School/Supervisor	Experienced
D	K-12 Generalist	Secondary	Administrator/Supervisor	Experienced
E	Educational Foundations	Elementary	Graduate Student	Novice

Lessons

Observers watched three, 30-minute lessons per classroom. Across the six lessons observed (three lessons in two classrooms), there were 16-18 students present in each classroom. The lessons included mathematics and language arts.

Lesson content during the observed lessons included standard Montessori curriculum and instruction during a morning learning cycle. Specifically, a typical two-and-a-half hour uninterrupted morning work cycle involved individualized lessons, materials implementation, and daily teacher observations. Student activity during these sessions included working at one's own pace. Teacher engagement included one-to-one and small group instruction. Because of the independence and self-direction required of students, they engage in portions of the lessons without the assistance of an adult.

Data Sources

The data for this study emerged from prompts on an observation tool as well as a follow-up survey of observers. The observation tool generated quantitative rating data and qualitative data

from the comments offered on the evaluation form. The survey generated small-scale quantitative data from closed-ended questions and qualitative data from the open-ended questions.

Observation tool and accompanying rubric. Each observer evaluated lessons using a tool informed by the Western State's Board of Education (pseudonym) criteria for teacher evaluations (see Appendix A for the competency statements on the observation tool). This tool reflected a validated, state-approved tool. It is appropriate for in-service teachers, and it contained generally expected areas of performance such as assessment, management, and instruction. Only teaching competencies that were directly observable were included on the observation tool. There was an option available to observers to indicate areas that were absent from typical lessons (e.g., work with families). The data analysis includes observer ratings, but also focuses on observer comments, generated from prompts on the tool. These data provide greater depth of understanding in this small-scale study.

Observers completed a training to use the tool through an online tutorial. The goal of the tutorial was to ensure that all observers had the same information about the observation process and tool, prior to the start of the observations. Observers reviewed a narrated PowerPoint presentation. The PowerPoint content included: 1) information on the observation process (i.e., dates and time for observations); 2) general information on completing the observation tool (i.e., noting the lesson topic, the subject matter, and observer name); 3) an explanation of the tool to be used while watching the observations (i.e., delineation of standards and competency items within those standards); and 4) instructions on how to submit final materials.

Survey. Immediately following observations, observers completed an on-line survey to determine their perspectives on reviewing the lessons using the telepresence robot (see Appendix B for the survey). The survey included 10 closed-ended and nine open-ended questions. Questions addressed attitudes toward in-person observations, attitudes toward the telepresence observational experience, and overall experiences as observers. The survey garnered a 100% response rate (n = 4) from eligible observers. Because of the survey focus, the one person who was not eligible to complete the survey was the in-person observer.

Data Analysis

The overall aim of the pilot was to assess the robot's impact on observers' perceptions of a lesson. We also examined if the robot was able to capture nuances of teaching within a classroom setting that included one-to-one interactions as a mode of instruction. Attitudinal surveys captured understandings of the observer experience. An analysis of data generated from the observation forms determined if, and under what conditions, telepresence robots might affect the particular evaluation of a lesson. Data were analyzed using descriptive statistics (Neuman, 2003). Data coding for themes included observers' comments on the rubric, along with the open-ended survey responses (Miles & Huberman, 1994). This analysis was completed with the assumption that observers' individual backgrounds, experiences, and stances affected interpretations of the lessons.

Findings

Through this pilot, we aimed for greater understanding in three focal areas designed to answer these questions: 1) Did the telepresence format allow observers to assess general teaching quality?; 2) Did the telepresence robot allow observers to observe the particular teaching competencies they would evaluate with an in-person, traditional mode of observation?; and 3) How successful or unsuccessful was the telepresence robot in evaluating specific pedagogical environments (i.e., Montessori classrooms)?

Did the Telepresence Format Allow Observers to Assess General Teaching Quality?

Despite the nuances of a classroom lesson and the varied observers, the telepresence robot method of observation allowed observers to identify and agree upon the overall quality of a lesson. Observers assessed general teaching quality through the quantitative ratings supplied through the rubrics, as well as the survey data.

Strengths of the Telepresence Robot

The observation tool prompted observers to rate each competency using a scale of Not Effective (0), Emerging/Minimally Effective (1), Effective (2), and Highly Effective (3). As Table 2 shows, despite evaluating the two classroom instructors from multiple locations through the telepresence robot, there were consistent ratings of the classroom, across all of the teaching competencies. Specifically, observers offered higher average scores for Classroom 1 than they

Table 2

Telepresence Observers' Average Rating for Each Classroom Competency

	CLASSROOM 1 Mean (0-3)	**CLASSROOM 2 Mean (0-3)**
Learner Development	2.50 (n=6)	1.60 (n=5)
Learning Differences	2.33 (n=9)	1.71 (n=7)
Learning Environments	2.25 (n=10)	1.63 (n=8)
Content Knowledge	2.56 (n=9)	1.57 (n=7)
Assessment	2.00 (n=9)	1.00 (n=3)
Instructional Planning	1.88 (n=9)	1.20 (n=5)
Instructional Strategies	2.02 (n=9)	1.11 (n=7)

did for Classroom 2 for each teaching competency. These data indicate that, through the telepresence robot, observers were able to assess the general teaching quality of each classroom. Despite the use of the telepresence robot during observations, all four telepresence observers agreed that the overall quality of instruction within one classroom was stronger than that observed in the second classroom.

Through the survey, remote observers were asked whether the telepresence robot would enable them to offer quality feedback to the teachers they observed. As Table 3 shows, when asked the question, "How effective or ineffective did you find the virtual supervisory robot to be in enabling you to offer quality feedback to the teachers you observed?", half of the observers said that the virtual supervisor was "somewhat effective," and the other half said the robot was "somewhat ineffective" in enabling their ability to "offer quality feedback" to the teachers as a result of their robot observation. Also, within Table 3, data demonstrate that this group of observers reported that they would choose to engage in a robotic supervisory experience in the future, with 3 observers saying "Yes" and 1 observer saying "Maybe" to this question.

Table 3

Telepresence Observers' Ability to Assess the Overall Quality of the Classroom

After engaging in the process of robotic supervision, how effective or ineffective did you find the virtual supervisory robot to be in enabling you to offer quality feedback to the teachers you observed?	
	Count
Not at all effective	0
Somewhat ineffective	2
Neither effective nor ineffective	0
Somewhat effective	2
Extremely effective	0
Total	4
Would you choose to engage in a robotic supervisory experience in the future?	
	Count
Yes	3
Maybe	1
No	0
Total	4

Actually participating in the robotic evaluation experience slightly exceeded observers' expectations and anticipations prior to observing using the robot. An observer wrote, "Robotic experience was almost as good as real-time observation with a few exceptions." Specifically, the strength of the robotic evaluation experience, enhancing their ability to offer quality feedback, was that observers viewed the teaching episodes real-time, during live lessons. This contrasts with a common method for evaluations of watching recorded observations. One observer noted, "[I] was able to observe the lesson as if I was in the classroom." Another observer said, "Having

a presence in the classroom with direct access to the teaching episode," put that observer in a position to offer quality feedback based on the lesson observation.

Telepresence observers enjoyed the convenience of being able to watch a lesson off-site from the classroom. Observers also said that having the ability to view virtually alongside other observers, who were simultaneously watching the same lesson, was a strength of this format for evaluation. One observer felt that the telepresence observation mode offered "the opportunity to participate in a collaboration from a distance. I enjoyed the chance to interact with the group and see instruction 'live' from a different state."

Observers felt that they were able to offer quality feedback because they could observe the instructor. Two observers indicated they could observe the "warmth" of the teacher and view the positivity of the instructor. Another observer noted seeing the "level of interest" in the children in the classroom. An observer said they could see "respectful interactions and support" on the part of the teacher. Another observer indicated that he/she also saw that the teacher was responsive to the students when they were working in front of the teacher.

Weakness of the Telepresence Robot

Observers noted that the telepresence format influenced their impressions of the lesson to some degree, due to periodic breaks in the audio transmission. These disruptions prevented observers from hearing the full interactions between teachers and students. This was evident on the observation tool with one observer indicating that the audio affected their evaluation of assessment, with the comment, "I was unable to hear, and so cannot comment on the feedback for the other two lessons that I observed." Audio affected observations of content knowledge for this observer also, as evinced by the comment, "I was unable to hear, and so I am unable to say whether the use of language was appropriate academic language or not." One observer said in response to the survey, "My guess is that the experience might not work so well in a classroom full of students. Because we observed only a few students at a time, we could mostly hear the students. I doubt this would work well in a full classroom because even if the teacher was hooked up to a microphone, you would be unlikely to hear students. This would diminish the experience significantly."

Beyond the audio, there were other instances where observers indicated that the telepresence robot inhibited observation. Observers reported that the weaknesses of the robotic experience were that it seemed appropriate only to lessons with fewer students and that the technology made it hard to see the full scope of the classroom and learning environment. One observer noted that they could not always fully view the classroom routines, procedures, or expectations when a teacher was working closely with a student.

Although some observers viewed the overall quality of the video projected from the robot as somewhat effective, attitudes varied on the robot's ability to show the classroom environment and the robot's ability to show the particularities of the lesson. Another observer could not necessarily determine the reasons behind a learning activity, as they commented, "Students are working on individually assigned tasks, but it's not clear to us as observers why each is doing the particular one they're doing." Even in whole group activities, some of the student work was not

observable through the telepresence format, as noted by one observer who said he/she could not see if students were "writing down anything" during their lesson.

Could the Observers Assess Particular Teaching Competencies Comparable to In-Person Observations?

In addition to assessing the overall quality of a lesson, observers evaluated the particular teaching competencies exhibited by instructors within the lessons they viewed. Observers evaluated the instructors' teaching competencies in the areas of learning differences, learning environments, content knowledge, assessment, instructional planning, and instructional strategies.

Comparing In-Person to Telepresence Observations

To determine whether the telepresence observations compared to in-person observations, the researchers investigated: 1) How did the telepresence observers' ability to rate teaching competencies differ from the in-person observer's ability to rate the same teaching competencies when viewing the same lessons?; and 2) Was there a difference in the remote observers' ability to rate teaching competencies through the robot than when they are generally observing lessons in-person?

In-person ratings versus telepresence ratings for the same lessons. The researchers compared the four virtual observers' ability to evaluate a competency as compared to the one in-person observer who viewed the same lessons at the same time as the remote observers. The evaluation tool allowed observers to offer an "N/O" option to indicate particular areas where telepresence observers were not able to observe a competency during the telepresence observations.

The telepresence observers and the in-person observer observed the same lessons simultaneously and used the same evaluation tool. The number of the "N/O"s were tabulated to reveal the competencies that observers could or could not observe during the telepresence robot observation. The number of the "N/O"s from the in-person observer was compared to the number of "N/O"s from the telepresence observers. The in-person observer was simultaneously viewing the same Montessori classroom lessons, but was physically present inside the classroom at the time of observation. As Table 4 shows there is a great deal of agreement between the in-person observer and the telepresence observers. Learning differences, content knowledge, and learning environments were competencies labeled as more accessible for evaluation, regardless of modality. Assessment, instructional planning, and instructional strategies were competencies deemed as less accessible by observers in both modalities. Learner development is the only competency for which there was disagreement, where the in-person observer found it accessible for evaluating, and the telepresence observers found it less accessible for evaluating.

Table 4

Comparing Rating Accessibility of Competencies Between In-person Rater vs Robot Observations

	IN-PERSON OBSERVER (number of "N/O"s)	TELEPRESENCE OBSERVERS (number of "N/O"s)
More Accessible to Rating	Learning Differences (0) Content Knowledge (0) Learner Development (0) Learning Environments (3)	Learning Differences (2) Content knowledge (2) Learning Environments (3)
Less Accessible to Rating	Assessment (5) Instructional Planning (6) Instructional Strategies (6)	Learner Development (7) Instructional strategies (8) Assessment (10) Instructional Planning (10)

In-person typical experience versus telepresence ratings for remote observers. The remote observers were experienced observers (Table 1). As such, the survey asked observers to reflect on that experience when, in a check-all-that apply question format, they were asked, "In general, what teacher competencies within a lesson are the most accessible to you, so that you are able to observe, score, comment, and offer feedback to at teacher without too much difficulty?" As Table 5 shows, telepresence observers said that, in their experience, when evaluating a lesson in-person, instructional strategies, learning environments, and content knowledge are generally competencies that are more accessible for evaluation. Learner development, learning differences, assessment, and instructional planning were typically less accessible to rating when evaluating in-person teaching episodes in the past.

The data generated from the "N/O" offerings from the robot observation evaluations were analyzed in conjunction with these survey data. When comparing the in-person lesson observation capabilities in the past to the evaluation of a lesson through the telepresence robot, there is agreement for what competencies are accessible to evaluating regardless of observation modality. That is, evaluating learning environments and content knowledge were generally more accessible to observers both when they have observed in-person in the past and through the robot. Learner development, assessment, and instructional planning were competencies that were less accessible to evaluating in both observation modalities.

Instructional strategies registered as more accessible to the observers when they typically observed in-person, and less accessible when they evaluated the lessons through the robot. Learning differences is an area that seemed less accessible to observers when they rated lessons as part of their past in-person experiences and more accessible to the same evaluators when evaluating the Montessori lessons through the robot.

Table 5

Comparing Rating Accessibility of Competencies of Past In-person Observations vs Robot Observations for the Remote Observers

	IN-PERSON OBSERVATION IN THE PAST (survey data)	TELEPRESENCE MODE (number of "N/O"s)
More Accessible to Rating	Instructional strategies Learning Environments Content knowledge	Learning Differences (2) Content knowledge (2) Learning Environments (3)
Less Accessible to Rating	Learner Development Learning Differences Assessment Instructional Planning	Learner Development (7) Instructional strategies (8) Assessment (10) Instructional Planning (10)

How Successful Was the Robot in Evaluating Pedagogical Environments?

The telepresence robot evaluated teaching episodes in Montessori classrooms, where small group and individual lessons were far more prominent than whole-class instruction. The telepresence robot was able to roam all over the classroom. The in-person observer noted that, in general, that the telepresence robot did not interfere with student learning, but there were times when the students took notice of it. The in-person observer noted, "Most students ignored the robot. The robot distracted some students who were working nearby because it had to move around to find the right place to be situated…Several students made some comments and asked questions about the robot to other students and the teachers." In general, however, the robot did not disturb the learning environment for the students. Telepresence observers assessed the robot tool in its ability to portray the classroom environment and the particularities of the classroom. Telepresence observers' knowledge of and experience with this particular pedagogical environment was assessed.

Ability to View the Classroom Environment

Learning environment was an area identified by all four observers as an area typically accessible to evaluating when observing a lesson. However, as Table 6 shows, even though the robot could move about the classroom, observers were split on whether or not the robot had the ability to show the classroom environment enough for them to offer a full evaluation. Two observers noted on their observation forms that they could observe the "general classroom," as they were able to note when children were working individually in a "self- directed learning experience" or with others in a group.

However, the other half of the observers said that it was harder to get the full context of the classroom when observing via telepresence robots, perhaps hindering their ability to evaluate the lesson they observed. One respondent said, "I missed some of the ability to see the whole room and behaviors of students from being present - where I can see what else is going on away from the focus of instruction." Another observer said in the survey, "I could only see what the robot was pointing to, so I couldn't be sure if the other students were engaged in meaningful work."

Table 6

Survey Questions Evaluating the Telepresence Robot's Showing of the Pedagogical Environment

How effective or ineffective were each of the following aspects of the virtual observation in assisting you to evaluate the lessons you observed?	
The robot's ability to show the classroom environment	Count
Not at all effective	1
Somewhat ineffective	1
Neither effective nor ineffective	0
Somewhat effective	2
Extremely effective	0
Total	4
The robot's ability to show the particularities of the lesson	
	Count
Not at all effective	0
Somewhat ineffective	2
Neither effective nor ineffective	1
Somewhat effective	1
Extremely effective	0
Total	4

Ability to View the Particularities of a Lesson

Montessori pedagogy requires close, individualized and small group instruction. As also shown in Table 6, when asked about the effectiveness of the robot's ability to show the particularities of a lesson, half felt that the robot was ineffective in this area. One observer was neutral, with one other observer saying "somewhat effective."

Observers understood that Montessori observations require attention to specific teaching strategies (e.g., attention to individuals, individualized decision-making) Montessori-informed pedagogy was noted in some performance evaluations. When evaluating learner development, for example, one observer said, "One-on-one with student followed Montessori model. No way to evaluate anything other than the direct instruction with the individual. Followed the typical Montessori protocol – only working with the single child and left others to work independently."

Observer Knowledge of the Pedagogical Environment

While one observer possessed expert knowledge of Montessori teaching, all observers reported they were able to offer quality feedback because of their general knowledge of Montessori lessons in early childhood education classrooms. One observer noted, "I am comfortable with typical academic expectations for children of this age and am able to identify progress markings in the way the teachers worked with the students, providing feedback, etc." On the observation form, with regard to the Montessori environment, an observer wrote that they could see a "classical Montessori presentation." Other observers noted the use of the Montessori manipulative tools in the classroom.

Discussion

Findings from this pilot study reveal strengths and weaknesses of the telepresence robot for observing teachers. As determined by the observation tool ratings and the observation comments, observers indicated they could offer an assessment of general teaching quality. Despite the nuances of a classroom lesson and the varied observers, the telepresence observation allowed observers to agree upon overall lesson quality as evidenced by the fact that they all were more favorable toward one classroom's instruction over the other. Further, when asked on the survey about whether or not they were ultimately able to offer quality feedback to a teacher, observers said they could.

A second finding from the pilot was that telepresence observers generally found that observing through the robot allowed them to assess most teaching competencies that they typically could evaluate in person. Observers found that learning differences, content knowledge, and learning environments were accessible to evaluation using the robot. Telepresence observers found it more difficult to offer an evaluation in the areas of learner development, instructional strategies, assessment, and instructional planning.

Notably, there was ambiguity on whether or not the telepresence robot would be effective for evaluating learning environments. Telepresence observers were generally able to evaluate learning environments within the context of the lessons they observed remotely. However, observers also identified challenges associated with telepresence observations. While observers were able to evaluate specific student-teacher interactions within the observed segment, the larger context of the classroom was less clear, as the telepresence robot only focused on the specific teaching and learning episode.

Instructional strategies was an area identified by all four observers as an area typically accessible when watching lessons. However, this was not an easily observed competency during the telepresence lessons for those viewing virtually or for the in-person observer. Therefore, it was not evident whether the mode (i.e., telepresence) hindered observations, whether instructional strategies were simply not prominent in the observed lessons, or whether the Montessori strategies used were not identifiable by some observers.

Learner development was a competency that the in-person observer of the Montessori lessons found to be more accessible to rating than the telepresence observers who viewed those same

lessons. That is, learning experiences that aligned with individual needs was evident in observations of the full classroom. Student choice and levels of independent work were more visible within the full class setting which was not always available to those viewing the classroom virtually.

While there are advantages to the telepresence observation, observers must require dedicated attention to modality, pedagogy and classroom environment when implementing this increasingly accessible mode for evaluation. In this study, a telepresence robot did not consistently allow for the successful transmission of the lesson's complexity, particularly with a unique pedagogy such as in a Montessori setting.

It is possible that the nuances of various classroom environments similar to a Montessori setting are more effectively captured in-person. For example, the teaching and learning process within lessons that involve inquiry-based activities, lab work, or student independent explorations require a unique set of interactions. As such, observations and subsequent supervisory support may require greater attention to the give and take between students and teachers and students and their peers. Findings from the current study indicate that these subtleties may be limited when using a telepresence without deliberate planning.

As part of the survey, observers offered recommendations based on the pilot. Pilot observers indicated that "careful consideration of the logistics," meaning doing the "leg work" for setting up the robot and ensuring that the audio is working properly, were necessary for the success of the observation. It was necessary that there be a person present in the classroom working with the robot "to capture all [that] the teacher is doing and where the teacher is moving." Observers must also consider whether the telepresence robot is effective for the focus of the lesson, which might require consultation with the classroom teacher beforehand to learn of the lesson format. For example, it "might be hard to see group work in detail in this way without constant movement" of the robot.

Observers indicated a preference for live and in-person observations when they said, "Certainly, there's a level of energy you just can't experience in the same way from a robot." and "Live and in-person is the best way to observe because the observer can see and hear everything that's going on...not just wherever the robot is pointing." However, telepresence robots offer observers advantages including flexibility and a contemporary format for information gathering that can inform evaluations. Yet it is not a panacea. For example, observers were ambivalent as to whether or not the telepresence robot was an improvement over watching video lessons. One observer noted that, "[The robot] experience does not allow [an] observer to go back over [the] lesson as would a video experience." Another observer reported, "I'm unclear about whether the robot experience is better than a video–it depends on whether the observer can see and hear everything the teacher and students are doing. The robotic experience is better than a video when the video only captures the teacher. Students need to be seen and heard as well."

Conclusion

Like all forms of observation, guiding educators in their work is complex and multifaceted. Nuances of observations, whether virtual or face-to-face, must include attention to technical skill

development as well as practices that encourage reflection on practice (Allen & Casbergue, 1997; Bates & Burbank, 2019). Although past research using a telepresence robot highlights the impact of support as a means of increasing efficiencies and interactive engagement across multiple individuals (e.g., Callahan et al., 2015), the current study provides insights into the long-standing significance of contexts and observer expertise, regardless of the mechanism used to review teaching practices.

Future research will include analyses of whether a telepresence can offer holistic profiles of teaching in ways that acknowledge contexts, observer expertise, and measures of quality that are defined and documented. A second round of observations using the telepresence robot may include an increased number of observations and a comparison of individual observers' responses as well as full group comparisons. These comparisons will extend data gathered through the pilot and will allow for further examinations of how observers' backgrounds impact perceptions of lesson content. These findings are particularly critical as classroom observers, particularly those who take part in coaching, student teaching experiences, or administrative roles, may or may not have the same content background as the individuals observed and evaluated. Additional research will allow for an increased understanding of the relationship between telepresence observations and the protocols used to both support and evaluate teaching quality.

Data from the current study highlight the unique lens of telepresence technologies. As such, training for observers and supervisors for all classrooms, including Montessori, must include attention to the range of variables that influence the integration of tools when visiting classrooms and reviewing teaching episodes more broadly. Specifically, we must determine whether evaluation criteria align with telepresence representations of contexts, nuances of lesson delivery, and accurate depictions of student-student and student-teacher interactions. Taken together, each of these variables must ensure student privacy is a priority. This goal is particularly critical for recognizing the lived experiences of students who are members of non-dominant cultural and racial communities. To reach this goal, educators must deliberately ensure children's rights to privacy as they engage in observations and supervision using various forms of technology by creating the necessary security protocols. Attention to these areas must guide educators who implement a telepresence to protect all involved.

While telepresence tools serve to evaluate teaching practices, they also have the potential to create supervisory opportunities that include teacher-to-teacher mentoring and coaching across classroom settings, including Montessori early childhood education classrooms. For example, within the context of international supervisory experiences, remote supervision has the potential to create communities where teams, coaches, and professional learning communities may work collaboratively to support growth (Relan et al., 2018). The contemporary virtual climate invites opportunities for explorations that substitute as viable alternatives to face-to-face teacher support. To be effective, these experiences must include dedicated planning, implementation, and evaluation of effectiveness. To reach these goals, effective instructional coaching, supervision, and mentoring require dedicated training (Bates & Burbank, 2019).

In addition to communication that promotes effective virtual supervision, training must include attention to action planning, the development and enactment of growth plans, and evaluations of

outcomes and impacts on individual and institutional operations (Kee et al., 2010). These same principles hold true for remote supervision conducted in all classrooms and are dependent upon elements of mentoring relationships that include in-depth feedback through conferencing. For example, observers and supervisors will need to determine whether virtual support adequately meets teachers' needs to ensure preparation that allows for coaching and mentoring, goal setting, and evaluations of the support provided (Relan et al., 2018).

Technology integration as a component of teacher observation provides multiple ways of looking into classrooms, creating non-traditional platforms for reflection on teaching, and expanding the contributions of observers. A telepresence within classrooms has the potential to capture teaching episodes and provide feedback in ways that reflect the characteristics of each classroom culture. However, telepresence tools are not without limitations that influence the lives of students and teachers. In addition to acknowledging the unique demands of communication using virtual formats, observers must attend to practices that ensure safety, security, and responsiveness to each individual and their varied needs. Realizing that the lives of many students within marginalized communities are particularly vulnerable, the action plan for implementing the tool must be deliberate and thoughtful in support of the individual privacy and personal experiences of all students.

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Author Biographies

Mary D. Burbank is a Clinical Professor, Associate Dean for Teacher Education, Professional Development, Engagement, and Director of the Urban Institute for Teacher Education in the College of Education at the University of Utah. Her teaching, research, and service examine teacher supervision, accreditation, and pathways to higher education for under-represented students.

Melissa M. Goldsmith is a Senior Research Associate with the Urban Institute for Teacher Education (UITE) in the College of Education at the University of Utah. As an evaluator for the Teacher Licensure Program, she applies her knowledge of research design and data management to accreditation efforts.

Alisa Bates is Dean of the College of Graduate Studies at the University of Western States. Her primary scholarly agenda includes work in mentoring and supervision of clinical experiences, including a recently published co-authored book, "Agency in Supervision and Mentoring: Reinvigorating the Practice" (2019).

Jennifer Spikner has held a wide variety of roles in the world of Montessori education including teacher, administrator, and teacher trainer. Jennifer has presented nationally and internationally on Montessori curriculum, diversity and social justice. She is currently the Head of School at Montessori Academy of Chicago.

Koeun Park is a PhD candidate in Education, Culture and Society at the University of Utah. Experience as a language educator informs her research interests in bilingual education for culturally and linguistically minoritized students. Using critical and social justice grounded theories and pedagogies she examines inequalities within bilingual education.

Appendix A

Project SCOUT Robot Observation Competency Statements

Scale= Not Effective (0), Emerging/Minimally Effective (1), Effective (2), and Highly Effective (3)

Standard 1: Learner Development The teacher understands cognitive, linguistic, social, emotional, and physical areas of student development.
1.1: Creates developmentally appropriate and challenging learning experiences based on individual student's strengths, interests, and needs. (1a, 2e)

Standard 2: Learning Differences The teacher understands individual learner differences and cultural and linguistic diversity.
2.1: Allows students different ways to demonstrate learning sensitive to multiple experiences and diversity while holding high expectations for all. (2a, 2b, 2c, 2d)

Standard 3: Learning Environments The teacher works with learners to create environments that support individual and collaborative learning, encouraging positive social interaction, active engagement in learning, and self-motivation.
3.1: Develops learning experiences that engage and support students as self-directed learners who internalize classroom routines, expectations, and procedures. (3a)
3.2: Collaborates with students to establish a positive learning climate of openness, respectful interactions, support, and inquiry. (3b)
3.3: Uses positive classroom management strategies including the resources of time, space and attention effectively. (3c, 3d)

Standard 4: Content Knowledge The teacher understands the central concepts, tools of inquiry, and structures of the discipline.
4.1: Bases instruction on accurate content knowledge using multiple representations of concepts and appropriate academic language. (4a, 4c, 4d, 4e, 7c)

Standard 5: Assessment The teacher uses multiple methods of assessment to engage learners in their own growth, monitor learner progress, guide planning and instruction, and determine whether the outcomes described in content standards have been met.
5.1: Uses data sources to assess the effectiveness of instruction and to make adjustments in planning and instruction. (5a, 5c, 5d, 8a, 9d)
5.2: Collects student progress and provides descriptive feedback to student, parent/guardian, and other appropriate stakeholders in a variety of ways (5b, 5e).

Standard 6: Instructional Planning The teacher plans instruction to support students in meeting rigorous learning goals by drawing upon knowledge of content areas, [State] Core Standards, practices, and the community context.
6.1: Demonstrates knowledge of the [State] Core Standards and references it in short- and long-term planning. (4b, 6a)

6.2: Integrates cross-content skills into instruction to purposefully engage learners in applying content knowledge. (6b, 6e)

Standard 7: Instructional Strategies The teacher uses various instructional strategies to ensure that all learners develop a deep understanding of content areas and their connections, and build skills to apply and extend knowledge in meaningful ways.
7.1: Practices a range of developmentally, culturally, and linguistically appropriate instructional strategies to meet the needs of individuals and groups of learners. (2b, 2e, 6c, 7a, 7b)
7.2: Provides multiple opportunities for students to develop higher-order and meta-cognitive skills. (3f, 6d, 7e, 7h)
7.3: Supports and expands learner's communication skills through reading, writing, listening, and speaking. (3f, 7d)
7.4: Uses a variety of available and appropriate technology and/or resources to support learning. (3e, 7f, 7g)
7.5: Develops learners' abilities to find and use information to solve real-world problems. (7f, 7g)

Appendix B

Project SCOUT Robot Observation Survey

Thank you for your participation in the Project SCOUT Robot Observation Study. For this study, you were able to observe multiple lessons as part of Project SCOUT at a local elementary school. You observed two teachers over three 30-minute lessons for a total observation time of three hours. Based upon your experience, please answer the following survey questions about your attitudes toward in-person as well as virtual observations.

TYPICAL, IN-PERSON OBSERVATION EXPERIENCES
Please consider your attitudes toward your typical, in-person observation experiences within a classroom setting as part of your role as an educator.

1. As an observer of teachers within a classroom setting, how important or unimportant are each of the following when evaluating lesson quality? *Scale= Not at all important (1), Somewhat unimportant (2), Neither important nor unimportant (3), Somewhat important (4), Extremely important (5)*
    a. The observer's knowledge of the curriculum
    b. The observer's knowledge of specific pedagogies
    c. The observer's knowledge of a classroom context
    d. The observer's knowledge of the grade level requirements

2. In general, what teacher competencies within a lesson are the most accessible to you, so that you are able to observe, score, comment, and offer feedback to a teacher without too much difficulty? (check all that apply)
    a. Learner Development
    b. Learning Differences
    c. Learning Environments
    d. Content Knowledge
    e. Assessment
    f. Instructional Planning
    g. Instructional Strategies

VIRTUAL OBSERVATION EXPERIENCE - THE ROBOT
Please consider your attitudes toward your virtual observation experiences within a classroom setting as part of this project.

3. After watching the lessons and completing the forms and/or notes, do you feel like you have quality feedback to offer the teachers who you observed virtually?
    a. Yes
    b. Maybe
    c. No

4. What were the factors that enabled you to offer quality feedback to the teachers you observed virtually? Why did you choose these factors?
5. What were the factors that hindered you in offering quality feedback to the teachers you observed virtually? Why did you choose these factors?

6. How effective or ineffective were each of the following aspects of the virtual observation in assisting you to evaluate the lessons you observed? *Scale = Not at all effective (1), Somewhat ineffective (2), Neither effective nor ineffective (3), Somewhat effective (4), Extremely effective (5)*
    a. The observation rubric score sheet
    b. The Powerpoint training module
    c. The overall quality of the video projected from the robot
    d. The overall quality of the audio projected from the robot
    e. The robot's ability to show the classroom environment
    f. The robot's ability to show the particularities of the lesson

7. Before engaging in the process of robotic supervision, how effective or ineffective did you expect the virtual supervisory robot to be in enabling you to offer quality feedback to the teachers you observed?
    a. Not at all effective
    b. Somewhat ineffective
    c. Neither effective nor ineffective
    d. Somewhat effective
    e. Extremely effective

8. After engaging in the process of robotic supervision, how effective or ineffective did you find the virtual supervisory robot to be in enabling you to offer quality feedback to the teachers you observed?
    a. Not at all effective
    b. Somewhat ineffective
    c. Neither effective nor ineffective
    d. Somewhat effective
    e. Extremely effective

9. Please indicate your level of agreement or disagreement with the following statements about the ways in which the virtual robotic observation may or may not have impacted you as an observer. *Scale = Strongly disagree (1), Somewhat disagree (2), Neither agree nor disagree (3), Somewhat agree (4), Strongly agree (5)*
    a. The virtual observation experience made me feel....
    b. Isolated
    c. Like I was working with others as part of a larger project
    d. No different from a typical, in-person observation

10. What do you consider to be the strengths of the robotic supervisory experience?
11. What do you consider to be the weaknesses of the robotic supervisory experience?
12. How does watching a video of a lesson compare to watching a lesson from a robot?
13. How does watching a live and in-person lesson compare to watching a lesson from a robot?
14. Would you choose to engage in a robotic supervisory experience in the future?
    a. Yes
    b. Maybe

c. No

15. What recommendations do you have for other teacher educators who may engage in the robotic supervisory experience?

OBSERVER CHARACTERISTICS

16. How much experience do you have in the following areas? *Scale = None at all (1), A little (2), A moderate amount (3), A lot (4), A great deal (5)*
    a. Observing teachers in Montessori classrooms
    b. Observing in-service teachers
    c. Observing pre-service teachers
    d. Where did you remotely observe from?

17. Please share any other comments you have about the Project SCOUT robotic supervisory project.

18. Your Name