teach live
3rd National Conference
Dissecting Education

June 4 & 5, 2015
University of Central Florida
Orlando, FL

Conference Organizer
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Foreword

This collection of papers from the third TeachLivE Conference represents a milestone in the R&D history of the technology. After many years of R&D, the Bill & Melinda Gates Foundation accelerated the work with an infusion of resources that made annual TeachLivE conferences possible – to share the uses, developments, and innovations in the technology. As such, the conclusion of this iteration of the conference and the publication of these papers cause the developers of TeachLivE to feel a wide range of emotions.

• We feel much gratitude toward the Bill & Melinda Gates Foundation for their financial support and, perhaps more importantly, their inclusion of TeachLivE in the conversation about reform in K-12 education.

• We feel honored to have developed partnerships with so many highly competent researchers, from so many prestigious colleges and universities, who have informed our practice and whom we call friends.

• We are elated that so many doctoral students and faculty members have published research articles about their experiences with TeachLivE.

• We are excited that we have met a challenge from the Bill & Melinda Gates Foundation to commercialize TeachLivE. We certainly are more than satisfied that Mark Atkinson has assumed the leadership of the company, Mursion.

• We do feel some sorrow that important TeachLivE members Arjun Nagendran, Carrie Straub, Morgan Russell, and Brian Kelly have left UCF, but delighted that they are still working with TeachLivE at Mursion. It is with sweet sorrow that former doctoral students Jackie Rodriguez, Stacey Hardin, Aleshia Hayes, and Darin Hughes have moved on to other universities and colleges to continue their careers.

• We are pleased that Felicia Graybeal, Kate Ingraham, Taylor Bousfield, Michael Hopper, Derrick Greenspan, and Donna Martin remain at UCF as a strong R&D team.

We are proud and humbled that so many attendees at the third TeachLivE Conference were returnees from one or both of the previous conferences. This continued dedication to the research surrounding the use of TeachLivE in education is fantastic.

This conference is a milestone in the development of TeachLivE, but it is not the final milestone. We assume there will be many other celebrations in the future because so many competent researchers are collecting data about the use of TeachLivE. We will strive to organize a fourth conference; we will continue to expand the number and types of avatars; we will continue to make software updates and transformations to further improve TeachLivE; and we will continue to invite and engage in numerous research partnerships with colleagues around the country and the globe.

Lisa A. Dieker
Charles E. Hughes
Michael C. Hynes
The Lived Experiences of Middle School and High School Teachers Utilizing TeachLivE as a Professional Development Tool
Kathleen Becht & Lauren Delisio
University of Central Florida

Abstract

A phenomenological study was conducted to explore nine secondary math and science teachers’ two years of professional development in the TeachLivE immersive, mixed reality classroom environment. Teachers experienced interactive professional development in their homes, schools, or at the University of Central Florida, via tablets, laptops, desktop computers, or laboratory interfaces. Teachers shared their one to two years of experiences and perspectives on these choices and flexibility for professional development in a virtual reality simulated classroom. While some teachers liked the choice and flexibility of professional development in their classrooms or homes, others maintained that they responded better to the formality of a professional location or setting. A preliminary review of the findings from this phenomenological study identified authenticity, interactivity, and technology access as key themes in the data.

Introduction

This study was a follow-up to previous studies in which secondary teachers increased their frequency of higher order questioning by repeated virtual rehearsals in an immersive virtual classroom laboratory. This study explored teachers’ perceptions and experiences of professional development using TeachLivE virtual rehearsal in an immersive mixed reality laboratory, and in the teachers’ classrooms and homes.

During this qualitative study, nine secondary teachers taught the same math or science lesson from a previous study to a classroom of five middle or high school student avatars. The teachers worked from home or at their schools through a Skype Internet connection, utilizing a desktop, laptop, or iPad device instead of traveling to the virtual classroom laboratory at the university. Researchers observed teachers during the lesson, collected data, and provided immediate feedback on the number of open-ended (higher order thinking) questions, and interviewed teachers about their experiences.

Theoretical Framework

A suspension of disbelief is required in order to engage in pedagogical activities using immersive virtual environments. Suspension of disbelief occurs when an individual ignores symbols that would typically interfere with the believability of an experience, such as contradictions, inconsistencies, and implausible scenarios (Lewis, Weber, & Bowman, 2008). Further, users must also experience the phenomenon of presence. Witmer and Singer’s definition of presence is widely accepted in the context of virtual environments: “the subjective experience of being in one place or environment, even when one is physically situated in another… As applied to a virtual environment, presence refers to experiencing the computer-generated environment rather than the actual physical locale” (1998, p.1).
Methods

Purpose of the Study

The purpose of this study was to explore the lived experiences of secondary math and science teachers who utilized TeachLivE across a variety of settings for professional development.

Research Design

A qualitative, phenomenological approach was used in this study. The research team collected several forms of data, including previous and current quantitative observational data for document analysis, field notes from TeachLivE sessions, and participant interviews.

Participants

Participants were identified from two previous years of the Gates TeachLivE studies. Thirty-two potential participants were identified based on the following inclusionary criteria: (a) teachers who participated in the Gates 1 (2012-2013) or Gates 2 (2013-2014) studies; (b) teachers of middle school math or high school science who were primary teachers of record in four rural, urban, and suburban public school districts in the southeastern United States; (c) teachers who participated in the intervention groups in the Gates 1 or Gates 2 TeachLivE simulation laboratory professional development studies. The research team contacted all 32 potential participants via email or phone. Nine teachers agreed to participate in the study.

Setting

The first and third phases of this study, the pre/post-observations, occurred in each participating teacher’s classroom during a lesson of his or her choosing. The second phase, the TLE sessions, were conducted either at home or in the classroom based on the teacher’s choosing, through Skype.

Procedures

This study took place in three phases over a period of two months. Before the study, the research team delivered a 10-minute orientation for each participant via Skype. The orientation served to explain the study as well as identify each teacher’s access to and understanding of the technology necessary to conduct the Skype-delivered TeachLivE sessions.

During Phase One, in a classroom observation of approximately 45 minutes, trained observers collected interval data on the number of open-ended questions the teacher asked during the lesson. This observational data was used for document analysis. Observers had been trained on the identification of open-ended questions via online videos.

Phase Two consisted of four 5-minute TeachLivE sessions. During each session, the participant taught a prescribed math or science lesson to the five middle or high school student avatars via Skype while the researchers collected data on the number of open-ended questions per session. Immediately following each session, the researchers provided feedback on the number of open-ended questions. Additional data collection included field notes regarding the
participants’ attitudes, non-verbal behaviors, and comments. Researchers conducted semi-structured interviews with a sample of teacher participants.

The final phase consisted of a second classroom observation of approximately 45 minutes in each teacher’s classroom following the four TeachLivE sessions. Again, trained observers collected interval data on the number of open-ended questions the teacher asked during the lesson, and used this observational data for document analysis.

**Trustworthiness**

The following practices will be used to ensure trustworthiness of data: audit trail through field notes and triangulation of data through the convergence of data sources (repeated observations in multiple environments; document analysis; semi-structured interviews).

**Preliminary Findings**

While some teachers liked the choice and flexibility of PD delivered to the classroom or home, others maintained that they responded better to the formality of a professional location or setting. A preliminary review of the findings from this phenomenological study identified authenticity, interactivity, and technology access as key themes in the data.

**Authenticity of Teaching**

Teachers identified critical differences between teaching the TeachLivE avatars through the ‘life-size’ screen in the UCF lab versus a Skype interface on a much smaller tablet, laptop, or desktop screen in the classroom or at home. One group of teachers thought the big screen in the lab provided a more authentic PD teaching experience. A high school science teacher said the big screen allowed him to stand in front of or walk among the students and easily see hands raised, or engaged versus disengaged students. Similarly, a middle school math teacher said she was able to control what and who she could see in the TeachLivE classroom lab, where she had little ability to do that on a personal device: “Zooming in is not the same as proximity control. When I’m teaching, I read the students’ facial expressions; that doesn’t come across online.” Another teacher’s experience reflected the difficulty of accessing TeachLivE over Skype: “It was more stressful over Skype [on a personal device].... It was harder to see and hear the students, and it didn’t feel as authentic...sitting at a computer. It didn’t feel like I was teaching.”

The experiences of these teachers appear as diverse as the teachers themselves. In contrast to the above statements, regarding suspension of disbelief with the avatars on the iPad, another high school science teacher said, “Though there may be more barriers using the iPad.... Once I got into the competition and play of it, my interface with the avatars was just as real and not inhibited at all...on the iPad.” Unlike the other eight teachers who sat while teaching the avatars on a personal device, this teacher chose to stand with the iPad at eye level in front of her because, she explained, it is how she teaches. “I’m always in with my kids.... I never sit. I never stand in front, ever.... I’m always in among the crowd.”
Interactivity

TeachLivE allows the user to pause the classroom at any point and start again. The pause classroom function allows for immediate feedback and reflection – vital tools in the classroom environment. Teachers in the study described the TeachLivE experience as fun, engaging interactive PD, where other PDs have been “a waste of time.” Another teacher exclaimed:

“I love it... Part of it is sort of like an instant gratification.... The other thing is that you can be very interactive and when you have all of this, you have sort of that instant feedback and it was good for me to see what my goals are, actually see it and then go back and try to do it.

Unfortunately, access to the Internet or web 2.0 programs across schools is inconsistent at best. Whether a result of student safety initiatives or lack of funding, this creates significant barriers. A number of teachers were unable to participate in or complete this study due to difficulty accessing the appropriate hardware of laptops and webcams, the Skype program on school computers, a LAN line [instead of a wireless internet connection], and/or internet blocks on the schools’ servers. When asked why she used an iPad, one teacher said, “The only problem with the laptops here [is they] don’t have webcams. My computer at home of course does. But when I bring my computer from home, all the internet is blocked on any personal computers.” Another teacher spent three hours with a school employee trying to set up a Skype connection. When the researchers tried to connect with her, she had reverted to a wireless device and was standing outside trying to connect. She was unable to complete the study.

When asked about the potential of the TeachLivE PD tool one teacher stated emphatically, “Yes, I would recommend this type of PD to other math teachers... This is an awesome program and has a lot of potential... [I] liked the small snippets to work on one technique like questioning, but would like to teach the full class period to develop a concept.”
Year Two: TeachLivE for Instructional Coaches
Cherie Behrens, University of Central Florida
Janice C. Franceschi, School District of Osceola County

Background

During the 2013-2014 school year, the School District of Osceola County implemented the first part of tailored instructional coaching professional development to K-12 district-level coaches. This training utilized TeachLivE to provide specialized and individualized training for district-level coaches. The district’s decision to prioritize this training is a result of the impact school coaches can have on student achievement (Fullan & Knight, 2011; Campbell & Malkus, 2011). The takeaways from the training were shared at the 2014 TeachLivE Conference, and the training won the state-level 2014 Florida Association for Staff Development Outstanding Professional Learning Practices Award for the School District of Osceola County.

Snapshot of the Use of TeachLivE in the First Training

TeachLivE was used in a variety of ways, including coaching practice with the single adult avatar, Ms. Adkins. In this instance, the coaches practiced working with Ms. Adkins – a new and open-to-coaching teacher and a resistant-to-coaching teacher in different sessions. The facilitator of the training also modeled coaching Ms. Adkins. Finally, on the last session date, the facilitator acted as a struggling teacher with a classroom of avatar students while the coaches observed and then wrote down their observations on a data collection “look for” form for later discussions on how to coach effectively without overwhelming the teacher. A facilitator’s guidance supported these discussions and, following the activity, the PLCs took turns in role-playing activities using the data from the “look for” forms to practice data-focused discussion using coaching language. Through session data collection, the district and facilitator learned what kind of support best helped the PLCs succeed in TeachLivE (e.g., providing more scaffolding, options about who to include in sessions with the avatar other than the coaching facilitator) and made appropriate changes for each new session as a result.

Through the TeachLivE experience, coaches engaged in realistic practice in the coaching role. Research supporting professional development for coaches says coaches are expected to have more experience than the teachers they work with, and often times need to hone the coaching skills that a new teacher needs in order to influence success in schools (Deussen et al., 2007; Blachowicz et al., 2010). TeachLivE offered powerful introspection and practice opportunities for coaches. For example, some coaches realized through reflection and feedback that they were using administrative language and, immediately after, began to practice the provided coaching language stems between sessions and before their next turn in TeachLivE.

Overall, the final data revealed coaches made significant gains and we were happy with the results and goals met; however, we were motivated to fine-tune training implementation.

Second Implementation Overview

The second part of the training implementation occurred during the 2014-2015 school year, whereby district-leaders worked with the series creator to collaboratively implement the
series to K-12 instructional coaches. The district leaders became district trainers of the series, upon completion of their collaborative implementation of the professional development to school-level instructional coaches in the spring of 2015. These new district trainers will now work to train school-based K-12 instructional coaches in their district to increase a pool of training coaches for schools, and to strengthen the coaching skills of existing site-based coaches. Neufeld and Roper (2003) explain that effective coaches need training tailored to their role.

**TeachLivE Takeaways**

The main purpose of this write up is to provide insight into new discoveries using TeachLivE while the district-level coaches and the series trainer worked with school level coaches during the second part of the training implementation. The format of the training stayed the same as the previous year, with the same number of training days (three), spread out so coaches could practice what they learned between sessions; the number of participants was similar, approximately 25. Again, each time the training occurred, coaches participated in a TeachLivE center rotation. Data continued to guide the training, but this time revealed a different story for TeachLivE experiences. Data revealed that this group needed more scaffolding within TeachLivE than the first group received during the training in order to be successful. This difference in needs from the first set of district level coaches to the second set of school-level coaches may have been attributed to the large number of new-to-coaching participants. Since scaffolding can help learners focus on what they are supposed to learn in problem-based situations, such as those found in TeachLivE, more scaffolding was employed to enhance learning (Hmelo-Silver, Duncan, & Chinn, 2007).

First we used what the data showed for the first group, that they would have preferred to ease into working in TeachLivE and gain their bearings by coaching a less resistant teacher. So, instead of putting this second round of participants into the “hot seat” right away with a resistant teacher, we decided to start the new group in a less demanding situation on day one of the training with Ms. Adkins as an open-to-coaching, new teacher. This change in no way diminished the cognitive rigor of the experience, as the goals included use of coaching language to work with a teacher and secure a future coaching opportunity in a short amount of time. Eventually, as we went through the training days and read our data stories from the participants, this group received a range of scaffolding that included what we provided for the first district-level coaches (e.g., coaching goals, coaching language templates, modeling, reflection, feedback, the option to have PLCs observe sessions) and more.

Below are some of the newly added, successful scaffolding tools we used for this latest round of school-based coaches:

1. Giving participants materials to read and practice prior to each face-to-face session, through the practice of flip teaching, in order to better prepare them for TeachLivE sessions.

2. Brief video usage allowed coaches to visualize the lesson they were to imagine they observed before the post-conference conversation with Ms. Adkins. They could use T-Charts or “look for” documents to collect data from the video to use with Ms. Adkins.
3. “Looks like” scaffolding sheet that showed a model for coaching Ms. Adkins: This sheet included icebreaker guidance and summarized what the coaching session should look like from beginning to end.

4. For the first session in TeachLivE, only the participant and facilitators observed the session to provide feedback afterward, unless the coaches stated a preference to allow their PLC group to watch and comment on their first time in TeachLivE. In the next sessions, most coaches wanted their PLC in their session for support and insight, which gave the group opportunities to hear from their peers in a constructive manner and gave their peers opportunities to apply coaching techniques and language to each other.

5. We gradually increased the “resistance” of Ms. Adkins for each day of the training.

6. The district-level facilitators were provided with guidelines on how to provide feedback to participants and guide the TeachLivE sessions. The district-level facilitators also received feedback on the coaching they gave school-based coaches in TeachLivE.

Below are some comments from school-based coaches specific to TeachLivE:

- "This was fantastic. I was very nervous, but the scaffolding (the script and context) helped ease my nerves, and I gained a lot of confidence and practice from this activity. Thank you so much!"

- "I like the impromptu practice at help with conversation with a teacher - we don’t always have practice at these conversations in our pocket."

- "Could we access TeachLivE coaching to practice coaching language?"

**Unexpected Entry of an “Outside Expert” in TeachLivE**

An avatar provided an unexpected layer of support when she asked to quietly listen in to the post-TeachLivE reflection and feedback conversations between the facilitator and coaching participants. This time the avatar was not Ms. Adkins the teacher, but rather in the role of an “outside expert” who did not participate in the discussions between the facilitators and the coaches; instead the avatar discussed insight with the facilitators about what Ms. Adkins the teacher was feeling and why she responded in certain ways during the simulation. This helped the facilitators and avatar determine that we were all on the same page, whether the feedback needed revision, or if Ms. Adkins’ operation in the future needed revision. In one instance, the main facilitator/series creator missed a moment of conversation between the coaching and Ms. Adkins that caused Ms. Adkins to retreat, as noted by crossed arms and short responses to the participating coach. Through conversations afterward with Ms. Adkins the “outside expert”, the main facilitator was able to gain a greater understanding of what occurred and better support the coaches’ learning. These practices made the TeachLivE experiences more seamless.

**Discussion**

Overall, our data story revealed that strategic immersion in TeachLivE, coupled with a variety of scaffolding techniques, improves educators’ learning, their openness to learning using a virtual environment, and their intentions to implement learned practices. Emerging research
suggests that educators who experience strategic professional development in TeachLivE are more likely to continue to use what they have learned at their school site compared to traditional professional development methods alone (Straub, Dieker, Hynes, & Hughes, 2015). Although this research is specific to the teacher educators studied, we are making an assumption that these findings will hold true for coaches who are former teachers as well. The district will continue to monitor the implementation efforts for school-based coaches and are optimistic that they too will take what they learned in the training and implement it at their respective school sites.

References


Using TeachLivE to Improve the Conversational Skills of Adolescents with Autism Spectrum Disorders

Claire Donehower
University of Central Florida

Introduction

Social skill and pragmatic language impairments are well documented in individuals with autism spectrum disorders (ASD) across the lifespan (American Psychological Association, 2013; Baghdadi et al., 2012; Bal et al., 2013; Howlin, Moss, Savage, & Rutter, 2013). Although early intervention can be effective in remediating some of the deficits in social skills for individuals with ASD, it is critical that explicit instruction in this area continue into adolescence and adulthood (National Autism Center, 2009). Social challenges impact the individual’s ability to succeed in his or her school and community, ability to access employment, and ability to demonstrate independence during the transition into adulthood (Howlin, 2013). In addition, although it was initially believed that the social deficits associated with ASD would abate naturally in adolescence and adulthood, recent findings suggest that this is not the case (Baghdadli et al., 2012; Bal et al., 2013). There are several interventions that have been effective in increasing targeted social skills in adolescents with ASD, including: (a) behaviorally-based interventions, (b) peer-mediated interventions, and (c) technology-based interventions (e.g., video modeling, use of virtual environments).

Peer-mediated interventions (e.g., Schmidt & Stitchter, 2012) and the use of virtual environments (e.g., Mitchell, Parsons, & Leonard, 2007) show evidence of efficacy in improving targeted social skills and promoting generalization. For this reason, it is important to investigate whether the combination of these treatments leads to more significant and durable effects. There are currently no studies that use this treatment methodology. This study will contribute to theory and practice by building upon the existing literature on peer-mediated and technology-based social skills interventions. Additionally, this study will explore a novel combination of intervention components (i.e., avatars as peer-trainers) and probe the effectiveness of this intervention in a non-traditional setting (i.e., the participant’s home).

Review of the Literature

Interventions based on basic behavioral principles and structured teaching methods are regarded as the most effective teaching strategies for individuals with ASD of all ages (National Autism Center, 2009). A treatment package that included visual supports and a self-management intervention was successful in increasing the frequency of follow-up questions asked by adolescents \(N = 2\) with ASD (Doggett, Krasno, Koegel, & Koegel, 2013). In a related study, researchers investigated the effect of a self-management intervention on the subjects’ \(N = 2\) participation in a conversation by answering questions, adding comments, and asking questions and found significant improvements in these targeted responses (Koegel, Park, & Koegel, 2014). Structured teaching interventions have also been employed to teach higher-level social skills such as perspective-taking and second-order perspective taking (Ozonoff & Miller, 1995).
Given weaknesses in methodology and instrument selection, it was difficult to assess whether the participants \( N = 9 \) had learned the skill of perspective-taking or learned how to answer the type of question on the assessment. White and colleagues (2013) implemented a cognitive-behavioral intervention that was designed to decrease participants’ anxiety and increase specific social behaviors (e.g., initiating with peers, recognizing social cues, etc.). This treatment package yielded gains in social functioning as measured by the Social Responsiveness Scale \( (d = 1.18) \). Overall, these studies demonstrate that a variety of behavioral interventions can be effective in teaching a range of social skill targets.

Peer-mediated interventions have also been introduced into treatment protocols in order to increase the likelihood that social skills would translate into the natural environment (i.e., school, home, and community). Schmidt and Stitchter (2012) examined the effect of peer-mediated initiation interventions (i.e., peer initiates interaction with participant) and peer-mediated proximity interventions (i.e., peer sits near participant but does not initiate interaction) on the frequency of appropriate and inappropriate initiation, responses, and continuations within a conversation. The peer-initiation intervention was more effective than the peer-proximity intervention in increasing total social interaction (TSI). Participant 1 showed a 50.9% increase in mean TSI from baseline to intervention, and Participant 2 showed a 20.9% increase in mean TSI from baseline to intervention. One of the major limitations of peer-mediated interventions is that the peer training process can be lengthy, involved, and unreliable.

Individuals with ASD tend to show increased interest and engagement in technology-based tasks and materials, making technology a potential vehicle for teaching social skills to children and adolescents with ASD (Chen & Bernard-Opitz, 1993). Video modeling has been used to teach academic, functional, and social skills to individuals with ASD at all age levels. Video self-modeling (i.e., showing participants videos of themselves engaging in the target behavior) is one strategy that has been shown to be effective in promoting social engagement in younger students with ASD (Bellini, Akullian, & Hopf, 2007). In addition, virtual environments provide a controlled venue for individuals with ASD to rehearse or role-play target social skills. Virtual environments have been used to teach basic social conventions such as how to select an appropriate seat in a café when there are many open seats or how to ask to sit at a table in a café where there are no empty tables (Mitchell, Parsons, & Leonard, 2007).

**Purpose**

The purpose of this study is to examine the effects of a social skills training package for adolescents with ASD that combines peer-mediated interventions and virtual environments by utilizing avatars as peer trainers. Since both types of intervention (i.e., peer-mediated and virtual environments) show evidence of efficacy in improving targeted social skills and promoting generalization, it is important to investigate whether the combination of treatments leads to more significant and durable outcomes for participants. Additionally, using avatars as peers may lead to increased procedural fidelity and decreased training time compared to traditional peer-mediated interventions. The research questions are:
1. To what extent does a peer-avatar-mediated intervention affect the total frequency of social behaviors (i.e., initiations, responses, and continuations) for adolescents with ASD?

2. To what extent does a peer-avatar-mediated intervention affect the individual frequency of social behaviors (i.e., initiations, responses, and continuations) for adolescents with ASD?

**Method**

**Research Design**

A reversal design (A-B-A-B) will be employed to assess the effect of the peer-avatar-mediated intervention. This design “provides a most convincing demonstration of causality available to applied researchers” (Gast, 2010, p. 251).

Participants’ baseline data will be collected for a minimum of three consecutive data points (Gast, 2010). Participants will not remain in the baseline condition for longer than five consecutive data points even if the data is not stable due to ethical concerns (e.g., inadvertently reinforcing dysfunctional communication patterns or behaviors). All participants will then move into the first intervention phase. The intervention will be reversed after “acceptable stability in both trend and level has been established in the first intervention condition” (Gast, 2010, p. 250). Again, all participants’ baseline data will be collected for 3-5 data points in the second baseline phase and then they will move into the second intervention phase.

Baseline and intervention sessions will occur twice weekly (Schmidt & Stichter, 2012) throughout the course of the study. Additionally, a pre and posttest measure of social reciprocity will be administered using the Social Responsiveness Scale (SRS).

**Population and Sampling**

The target population for this study is individuals who (a) have a diagnosis of ASD, autism, or pervasive developmental delay (PDD), (b) are between the ages of 13-21, and (c) show interest in interacting with avatars.

A sample size of three participants was chosen based on professional convention (Gast, 2010; Horner, Swaminathan, Sugai, & Smolkowski, 2012; What Works Clearinghouse, 2014). Convenient sampling was used to identify the participants for this study. Demonstrations of TeachLivETM, an interactive, mixed-reality simulator, were used to screen participants for general interest in interacting with the avatars. Participants who successfully completed the screening process were selected from different geographical areas within the United States (i.e., Florida, Maryland, California).

**Data Collection**

After the three participants were identified, the researchers obtained informed consent from a parent or guardian. During the consent process, the parents or guardians received a thorough explanation about study procedures, efforts to protect confidentiality, any possible incentives for participating (e.g., improvements in social reciprocity), and the right to withdraw.
from the study at any time (Gall, Gall, & Borg, 2007). Finally, participants were provided with the equipment needed to run the simulator in their home environments (i.e., laptop computer with necessary programs).

After equipment was set up, parents were trained on how to use the study equipment. Additionally, interactors were trained on the intervention protocol and demonstrated 100% procedural fidelity during role-plays after the formal training. The data collection for this study has three main components: (a) pre and posttests using the Social Responsiveness Scale, (b) frequency data of target behaviors will be collected during baseline and intervention phases, and (c) social validity measures completed by the participant’s parent or guardian.

Instrumentation

The pre and posttest measure that will be used to assess overall social functioning is the Social Responsiveness Scale (SRS), which is a 65-item questionnaire that can be completed by a parent or teacher. “The instrument inquires about specific and observable elements of specific reciprocal behavior (39 items), social use of language (6 items), and behaviors characteristic of children with autism and other PDDs [pervasive developmental disorders] (20 items)” and takes only about 15-20 mins to complete (Constantino & Todd, 2003). This instrument has high internal reliability (α = .94 - .97), high test-retest reliability/construct validity (r = .80 - .95), and strong inter-rater reliability/convergent validity (r = .61 - .91; Constantino, 2013). The SRS is more sensitive to small differences in social impairment than other instruments that are frequently used for both diagnosis and assessment (e.g., Autism Diagnostic Interview – Revised; Constantino et al., 2003).

During baseline and intervention phases, frequency data will be collected on the following target behaviors: (a) initiations, which are operationally defined as any motor or vocal behavior directed to a peer that attempts to occasion a response, (b) responses, which are operationally defined as any motor or vocal behavior directed to a peer that acknowledges an initiation within five seconds, and (c) continuations, which are operationally defined as any response (e.g., comment or question) directed to a peer that maintains an ongoing interaction (Schmidt & Stichter, 2012). All sessions will be coded live through a laptop webcam by a member of the research team and at least 20% of the sessions in each phase will be coded by a second member of the research team to collect inter-observer agreement (What Works Clearinghouse, 2014).

Finally, to assess the social validity of the intervention, parents or guardians will be asked to rate the significance of the goals, the social appropriateness of the procedures, and the social importance of the effects (Wolf, 1978).

Data Analysis

For studies that employ a single-subject design, it is typical for researchers to use a combination of visual analysis techniques and descriptive statistics (Gall et al., 2007). In some cases, researchers using this design will also use inferential statistics (i.e., t tests) to compare
pooled means of the baseline and intervention phases in the place of visual analysis (Gall et al., 2007). As shown in Table 1, visual analysis, descriptive statistics, and inferential statistics will all be used in order to interpret the data and answer the two research questions. Mean baseline difference (MBD) and percent of non-overlapping data (PND) will be the descriptive statistics used for this study and are both measures of effect size. “The MBD is designed to provide an index of the change of level of behavior across baseline-treatment conditions” (Gast, 2010, p. 440). “The PND can range from 0 to 100; a PND greater than 90% reflects a highly effective treatment, a PND of 70-90% is considered a fair treatment outcome, and a PND of less than 50% indicates unreliable/ineffective intervention” (Gast, 2010, p. 441). Finally, t tests will be used to compare the means of baseline, intervention, and generalization phases. Additionally, t tests will be used to compare the means of pre and posttests scores on the SRS.

Table 1
Data Analysis Procedures

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Data Analysis Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1: To what extent does a peer-avatar-mediated intervention affect the total</td>
<td>Peer-avatar-mediated</td>
<td>Frequency of initiations, responses and</td>
<td>Visual analysis</td>
</tr>
<tr>
<td>frequency of social behaviors (i.e., initiations, responses, and continuations)</td>
<td>intervention</td>
<td>continuations</td>
<td>- MBD</td>
</tr>
<tr>
<td>for adolescents with ASD?</td>
<td></td>
<td></td>
<td>- PND</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- t test (comparing means of baseline and intervention phases)</td>
</tr>
<tr>
<td>R2: To what extent does a peer-avatar-mediated intervention affect the individual</td>
<td>Peer-avatar-mediated</td>
<td>Frequency of initiations, responses and</td>
<td>Visual analysis</td>
</tr>
<tr>
<td>frequency of social behaviors (i.e., initiations, responses, and continuations)</td>
<td>intervention</td>
<td>continuations</td>
<td>- MBD</td>
</tr>
<tr>
<td>for adolescents with ASD?</td>
<td></td>
<td></td>
<td>- PND</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- t test (comparing means of baseline and intervention phases)</td>
</tr>
</tbody>
</table>

There are several potential limitations of this study with the research design, sampling procedures, and data collection procedures or instrumentation. The reversal for this study has strong internal validity, but does have some potential threats including short baseline phases, which can complicate the analysis of the treatment effect (Gall et al., 2007), and the lack of intra-subject replication (Gast, 2010). Single-subject designs, such as the reversal design, typically
have low external validity. One threat to external validity will be the small number of participants \( N = 3 \) who are functionally similar on very specific criteria but who vary significantly on other criteria. Although efforts will be made to recruit participants from diverse backgrounds and areas of the country, the generalizability of the results will still be limited.

Additionally, the study has several potential limitations in the data collection procedures. First, the frequency data that will be collected during baseline and intervention will be coded from video recordings. When using a webcam or other video-recording device, there are possible limitations with the clarity of the recording, overall visibility, and technical issues (e.g., camera freezing, not recording entire session). Additionally, the pre and posttest measure (SRS) instrument is completed by a parent or teacher and therefore is subject to reporter error and bias.

**Implications**

This research study will contribute to the bodies of research on social skills instruction with adolescents and adults with ASD and the research on the use of technology-based interventions with individuals with ASD. By combining a modified-peer-mediated intervention with a technology-based intervention, this study will investigate whether using an interactor to implement the intervention requires less training time and results in greater fidelity of implementation. These findings will have the potential to influence how social skills are taught and generalized across multiple settings (e.g., home, community, school).

The findings of this study will also explore the implementation of social skills interventions in the home rather than in a clinical or school setting. Social skills instruction is frequently delivered by teachers or school-based related service providers (e.g., speech-language pathologists or school counselors) or outpatient providers (e.g., social skills group leaders, speech-language pathologists, psychologists) and supported by parents and families in the home. With changing mandates for schools and the adoption of the Common Core State Standards by many states, it is possible that the time allocated for direct social skills instruction will be reallocated. For this reason, it is important to investigate alternative ways to provide this instruction to children and adolescents with ASD.

Future research should look at the efficacy of this intervention with different target social skills. Researchers could also sample participants of different ages and participants with different communication profiles. Additionally, researchers should seek to understand the most effective “dosage” of this intervention (i.e., frequency and length of intervention sessions).

**References**


Infusing Culturally Responsive Strategies in STEM Instruction for Special Education Teachers

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Illinois State University

Introduction

Mathematics education for K-12 students is in crisis considering the importance of mathematical literacy and knowledge in a competitively global society (Ukpokodu, 2011). Students in urban and rural areas have the most to lose due to non-engaging practices and strategies for this student population (Ukpokodu, 2011). Historically, special education teacher preparation programs have focused on equipping teachers with knowledge of inclusive practices, assistive technology, and behavior management strategies (Leko, Brownell, Sindelar, & Murphy, 2012); however, there is a gap between research evidence and classroom practices (Cook & Schimner, 2006). Consequently, special education teacher preparation programs now offer coursework focused on evidence-based practices and their use in the classroom.

According to Aguirre, Zavala, and Katanyoutanant (2012), teachers understand the importance of mathematics, and teach concepts based on mathematic fundamentals; however, when taught only mathematic fundamentals without tying concepts to real life situations, diverse students remain disengaged. Culturally Responsive Teaching (CRT) pedagogy could offer solutions. Torres-Valesquez (2005) posits that “culturally responsive teaching is a dynamic form of teaching that builds on and supports students’ home culture” (p. 249). By implementing CRT strategies in the math classroom, future teachers could begin helping students make connections between mathematics and the real world, and maintain engagement in mathematical concepts.

The study proposed to examine two professional development methods – online modules and a teacher preparation simulation (TeachLivE) – to analyze differences in increasing the use of Culturally Responsive Teaching (CRT) strategies. We posed the following research questions:

1. Will pre-service teachers enrolled in an urban initiatives track perceive their performance in TLE TeachLivE at a higher level than students not enrolled in the urban initiatives track in regards to effectively delivering a CRT lesson plan in TeachLivE?
2. Will pre-service teachers enrolled in an urban initiatives track out-perform pre-service teachers in the traditional math methods track in delivering a lesson in TeachLivE?
3. Does the use of TeachLivE and online asynchronous professional development, versus online asynchronous professional development only, better prepare pre-service teachers to be culturally responsive teachers?

Methodology

Participants

Participants included undergraduate students with no clinical experience studying special education. The study consisted of 62 (N=62) students enrolled in a Math Methods course for learners with disabilities, in the spring semester. Participants were recruited from three sections of the Math Methods course. Two sections were considered urban threaded sections (n=42), and
the final section was traditional, with less emphasis on an urban school setting (n=20). To answer research questions one and two, researchers used the entire sample of participants from the traditional section (n=20) and a randomly selected sample of 20 participants (n=20) from the urban section to ensure equal groupings. The total sample for questions one and two was N=40.

Setting

The study took place in the Midwest region of the United States at a public university. The university demographics are as follows: 20.6% are minorities (American Indian/Alaskan Native, Asian, Black/African American, Hawaiian/Pacific Islander, Hispanic, or Two or More Race Selections); 79.4% are White/Caucasian. In regards to communities in which students reside, 59.2% of students are from Midwestern suburban areas. Within the public university, the study was set in a quiet classroom equipped with the TeachLivE technology. Participants were able to complete the study requirements within this specific setting.

Procedures

Participants (N=62) were randomly assigned to a control group or an experimental group. Within each group, participants were then randomly assigned to the CRT group or the High Quality Math Instruction group. Both groups, the control group and the experimental group, received access to professional development modules and created mathematics lesson plans. Although all participants received professional development modules, some received a CRT module while others received a High Quality Math Instruction module, hence the need to randomly assign students within their original groupings. Differences between the control and experimental groups in regards to what they received during the study are as follows:

Table 1. Control Group versus Experimental Group

<table>
<thead>
<tr>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provided Professional Development Module</td>
<td>Provided professional development module</td>
</tr>
<tr>
<td>Create Lesson Plan</td>
<td>Create a lesson plan</td>
</tr>
<tr>
<td>Receive Feedback</td>
<td>Observed in TLE (10 min)</td>
</tr>
<tr>
<td>Reflection</td>
<td>Receive feedback</td>
</tr>
<tr>
<td></td>
<td>Reflection</td>
</tr>
</tbody>
</table>

The study consisted of each student’s lesson plan development. Participants were asked to create a mathematics lesson plan after completing their randomly assigned professional development module. Lesson plans were analyzed based on a rubric based on CRT principles. Participants then interacted in the TeachLivE lab and were scored based on the rubric. The lesson plan and lab interaction scores were analyzed to determine any differences between the control group and the experimental group, as well as the CRT module group versus the High Quality Math Instruction module group. Participants were also given the TLE TeachLivE perceptions questionnaire (Hardin, 2013). To further understand participants’ perceptions of their lesson delivery in the lab, the questionnaires were analyzed and results are presented herein.
Results

Two independent t tests were conducted to answer research questions one and two. In regards to research question one (Will pre-service teachers enrolled in an urban initiatives track perceive their performance in TeachLivE at a higher level than students not enrolled in the urban initiatives track in regards to effectively delivering a CRT lesson plan in TeachLivE?), no statistically significant difference was found between participants enrolled in an urban initiatives track versus students not enrolled in the urban initiatives track. This study found that participants enrolled in the traditional section of the Math Methods course perceived their ability to effectively deliver a CRT lesson plan higher (m = 4.10, d = .788) than students enrolled in the urban initiatives section (m = 3.88, d = 1.023; t(38) = .707, p = .485).

The second question (Will pre-service teachers enrolled in an urban initiatives track outperform pre-service teachers in the traditional math methods track in delivering a lesson in TeachLivE?) used a sample of 38 participants from the total 62 students. Researchers found a statistically significant difference between participants enrolled in traditional track (m = 43.35, d = 6.961) and participants enrolled in the urban initiatives track (m = 49.48, d = 6.221). Participants in the urban initiatives track outperformed participants in the traditional track in regards to their performance in the lab, t(38) -2.934 p = .006.

Results for the third research question (Does the use of TeachLivE and online asynchronous professional development, versus online asynchronous professional development only, better prepare pre-service teachers to be culturally responsive teachers?) was found insignificant. The full sample of N=62 was used to answer this research question. An independent t test was conducted to analyze if participants receiving TeachLivE and online asynchronous professional development was statistically significant than participants only receiving online asynchronous professional development. Researchers found no statistically significant difference between participants who received TeachLivE and online asynchronous professional development (m = 48.167, d = 6.255) versus participants who only received the online asynchronous professional development (m = 45.390, d = 9.528; t(62) = 1.346, p = .183).

Discussion

Three research questions were posed and answered as a result of the current study. The first and second questions addressed lesson plan creation and delivery within the TeachLivE lab, while the third question examined the amount of professional development participants received.

The first research question assessed the participants’ perception of their lesson delivery within the TLE TeachLivE™ lab. Results showed that participants enrolled in the traditional track of math methods perceived their delivery at a higher rate on the TLE TeachLivE™ perceptions questionnaire (Hardin, 2013) than their peers enrolled in the urban initiatives track. However, when the researchers analyzed the scores of lesson creation and delivery within the TLE TeachLivE™ lab, it was found that participants in the urban initiatives track outperformed their peers in the traditional track. Although there was not a statistical significance difference between perceptions of performance in the lab between participants in the urban initiatives section versus the traditional section, the difference between perceptions and actual performance could be due to lack of confidence. Prior to the study, participants did not have any teaching
experience; this could be addressed as participants gain more teaching experience in Math instruction as well as CRT strategies.

The final research question addressed two professional development models, TLE TeachLivE™ and asynchronous online modules (experimental group) versus only asynchronous online modules (control group). Researchers found no significant difference between the control group and experimental group; however, more in-depth research should be conducted to further analyze professional development delivery methods.

**Conclusion**

The purpose of this study was to further understand the effects TeachLivE may have on developing CRT skills in pre-service teachers. Researchers conducted three independent t tests to answer three research questions. For two out of three questions, researchers found analyses to be insignificant. However, for the second research question (Will pre-service teachers enrolled in an urban initiatives track out-perform pre-service teachers in the traditional math methods track in delivering a lesson in TeachLivE?), researchers found significant results indicating participants enrolled in the urban section outperformed participants in the traditional section in regards to increasing culturally responsive teaching skills. A replication of this study should be conducted using a larger sample size of students enrolled in the traditional setting to further understand the results. There should also be future research on professional development options to help teachers with their CRT skills. As reported by Torres-Velasquez (2005), CRT is a powerful teaching style that will allow students to thrive academically in a warm and safe school environment. If future teachers are not provided instruction on CRT while teaching math, it is possible that instruction would not be relevant or tied to real life experiences.

**References**


English Language Learner (ELL) Avatars for Pre-Service Teachers

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Introduction

Pre-service teacher candidates often report feeling unprepared to work with culturally and linguistically diverse learners (Mergler & Tangen, 2009). While they are busy learning content and how to teach that content, they may feel overwhelmed when asked to add the responsibility of making the content comprehensible to English learners (ELs). Yet beginning PK-12 teachers increasingly enter classrooms filled with diverse learners, many of whom are not yet fully proficient in English, their second language.

Following the passage of the Consent Decree in 1990 (DOE), county school systems become responsible for English training for speakers of other languages (ESOL). Each school system created 300 hours of staff development, usually with videotaped lessons for accessibility in a variety of locations at flexible times. Eventually the Department of Education moved the English for Speakers of Languages (ESOL) endorsement to the pre-service level. Colleges of Education were tasked with creating professional development to prepare faculty to work with the teachers-in-training. Finally, all teacher education programs were revised to include the ESOL endorsement.

The University of Central Florida’s state-approved teacher preparation program uses an infusion model where teacher candidates take two stand-alone ESOL classes, and ESOL content and assessments are infused into other classes. Weisman and Garza (2010) recommend including an emphasis on linguistic diversity throughout teacher preparation curriculum so that pre-service candidates will have repeated and varied exposure to this crucial issue. However, the effects of activities and assignments infused into general teacher preparation courses are not well established. Preparing teacher candidates to address English language learners’ needs must be a natural part of planning, carrying out, and evaluating instruction in their content areas. With this in mind, the UCF ESOL faculty wanted to strengthen aspects of the ESOL endorsement.

Enter the EL Avatars

In order to prepare our teacher candidates for the EL students in their future classrooms, we used the mixed reality environment of TeachLivE in this study. TeachLivE is an avatar-based simulated classroom simulation environment that combines both human intelligence and computer animations. Faculty in the College of Education and Human Performance and the College of Engineering and Computer Science at the University of Central Florida (UCF) created the simulation classroom to provide teacher candidates with opportunities to engage in teaching practice without the probability of affecting any students. The use of the simulation classroom began approximately 10 years ago, and today, over 120,000 teachers and 540 universities are using the classroom simulation lab. In this environment there is a high level of fidelity and validity in that researchers can script the critical components measured in the interaction to measure the responses of teachers or students. This environment is used to evoke personalized...
learning and the suspension of disbelief by giving teachers an environment that looks, feels and reacts like a real classroom, yet the students in the classroom are avatars (Dieker, Rodriguez, Lignugaris/Kraft, Hynes, & Hughes, 2014).

TeachLivE’s English learner avatars have provided astonishing opportunities for pre-service and in-service teachers in the College of Education and Human Performance to practice their teaching skills. Currently, two of the core courses offered in multiple sections each semester utilize TeachLivE for the purpose of teacher preparation and practice. TSL 4080 “Theories and Practices of Teaching ESOL Students in Schools” and EDG 4410 “Teaching Strategies and Classroom Management” are both pioneers of the vast possibilities TeachLivE has to offer our teachers in training.

**TSL 4080**

In TSL 4080, an introduction to the world of teaching English, students become familiar with different levels of proficiency and learn about various approaches they can pursue to meet English learners’ needs. Prior to meeting and interacting with the avatars, the teacher candidates in this class are introduced to Edith, Edgar, and Tasir’s cases and learn about how each avatar represents a level of proficiency and background they will encounter as teachers in their mainstream classrooms. An interactive workshop precedes the TeachLivE session to give the students an opportunity to work in small groups and practice the types of questions they can ask English learners at different levels.

**EDG 4410**

A general methods course, Teaching Strategies and Classroom Management, is the second exposure to the EL teaching cases. The junior-level course is required of all elementary and secondary education majors. In this course the teacher candidates explore instructional, organizational, and classroom management strategies to create effective learning environments. Included in the course requirements are a 15-hour service-learning field experience and two microteaching sessions. As the teacher candidates create lesson plans for the sessions, they meet the three EL students – Edith, Edgar, and Tasir – in the teaching cases via an online module. The lesson plans must contain ESOL accommodations for each EL with a detailed explanation of each accommodation and why it would help the EL at his or her level of language proficiency.

**The Study**

A mixture of qualitative and quantitative data were collected in order to examine teacher candidates’ sense of self-efficacy in meeting the needs of ELs as a result of the courses and experiences with the EL avatars. Students were given a choice of whether or not to participate in the TeachLivE experience, and all students were surveyed both before and after the opportunity to use TeachLivE. In addition to the surveys, all students who participated in the classroom simulation were asked to write a reflection following their experience. The researchers in this study attempt to answer the following research questions:

1. What is the perceived level of preparedness of students in a general methods class to teach English learners in a regular K-12 classroom setting?
2. Will teacher candidates’ sense of efficacy related to teaching English learners change as a result of the simulation?

Participants

Participants in the study were 122 teacher candidates enrolled in EDG 4410. Fourteen percent of participants were male; 86% were female. Twenty-two of the respondents did not indicate their gender on the survey. Two percent were African American; 6% were Asian; 70% were Caucasian/White; 18% were Hispanic/Latino; 1% were Middle Eastern; 1% were Native American; 2% were multiracial. English was the first or native language of 91% of the participants; 9% had a first or native language other than English. Ninety-one percent of the respondents identified themselves as native speakers of English; 9% identified themselves as non-native speakers. Twenty-three respondents did not identify themselves as either. Eighty-nine percent of the non-native English speakers had been considered ESOL students during their PK-12 schooling. All were invited to participate in the TeachLivE experience and 32 participated.

The candidates who chose to participate in TeachLivE had the opportunity to teach a class with the three EL avatars included in a class of five avatars. The sessions take place in the TeachLivE lab with TESOL experts who observe and coach the teacher candidates. After teaching the lesson, students discuss their lessons with the TESOL experts and receive feedback on their performance and recommendations on how they can improve their teaching skills. After the TeachLivE experience they are asked to write a reflection answering the following questions:

1. What are your thoughts about using TeachLivE as a tool for teaching practice?
2. How would you compare your TeachLivE experience to a real classroom of students?
3. What did you feel were the strengths and weaknesses of your lesson overall?
4. What did you think about your interactions with Edith, Edgar, and Tasir during your TeachLivE lesson?
5. How did the strategies you prepared for the English learners (such as leveled questions, show and tell strategies) work for Edith, Edgar, and Tasir in your lesson with TeachLivE?
6. Explain what you learned about teaching English learners as a result of your TeachLivE experience.
7. Explain what you would do differently for the English learners if you had the opportunity to redo this lesson.
8. Do you have any other comments you would like to share about your TeachLivE experience?

Results

In this study, we sought to determine the sense of self-efficacy of teacher candidates related to the instruction of ELs and whether the simulation classroom experience would impact their sense of self-efficacy. The findings from the self-efficacy surveys taken both before and after the TeachLivE experience as well as the findings from the reflections of those students who participated will be presented.
The findings of this study did not reveal a statistically significant difference between the pre-survey scores and post-survey scores of the teacher candidates who participated in the simulation classroom and those who did not. All teacher candidates rated themselves very high in their perceptions of their abilities to incorporate ESOL strategies. Although the differences were not statistically significant, the means of all teacher candidates increased from the pre-survey to post-survey in terms of their sense of efficacy and their knowledge of ESOL content and infusion. The written reflections from the simulation classroom participants clearly communicated many benefits from use of the classroom simulation. The teacher candidates identified specific ESOL strategies they plan to incorporate into their teaching. Many candidates identified the need for more visuals, better questioning strategies, and the need to speak more slowly.

Teacher candidates valued the opportunity to practice in a simulation classroom before working with students in K-12 classrooms, and expressed gratitude for the opportunity to participate. This type of experience is the future of teacher education, and the next phase of research will regard how these types of experiences are harnessed to maximize the impact on teacher candidate practice and, ultimately, student learning.

References


Using TeachLivE Across the Developmental Continuum for New Teachers

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Abstract

This paper discusses the use of a simulated teaching environment, TeachLivE, to increase the skills of teacher candidates across the continuum of one teacher education program. Candidates in this program are given multiple opportunities to work in TeachLivE to build competencies in instruction, collaboration, and communication. A variety of models are used (e.g., real-time coaching, tag-team interactions, peer support and coaching, video reflections).

Introduction

The Department of Special Education at California State University, Northridge (CSUN) began using TeachLivE about three years ago. We consider TeachLivE to add significant value to our program in a variety of ways. Research tells us that teacher candidates need constructive, systematic, and immediate feedback on their teaching in order to make maximum progress (Coulter & Grossen, 1997; Scheeler, Ruhl, & McAfee, 2004; Sharpe, Lounsbery, & Bahls, 1997). TeachLivE allows us to give immediate feedback in a way that is not possible in a real classroom, using the real-time coaching method: As a candidate is teaching, we stop the lesson, discuss student progress, then give the candidate the option to try again and receive more feedback. This has been an important addition to our program and allows our students to reflect on their teaching “on the spot”. Additionally, we know that two areas of need for new teachers are the development of collaboration skills between general and special educators (Santagata & Guarino, 2012; Stein, 2011), and interactions with parents (Murray, Mereoiu, & Handyside, 2013). Typically, new teachers begin their careers having had little or no opportunity to develop these important proficiencies. TeachLivE has given us a vehicle to prepare our teachers in these critical skills, including feedback from peers and faculty, and the opportunity to view video of the interaction for later reflection.

Pre-service candidates in the CSUN Mild/Moderate Disabilities teaching credential program have the opportunity to engage in the TeachLivE lab during three courses in the program. The experiences are arranged developmentally, beginning with basic teaching skills and moving into more advanced competencies critical to new educators. The first course, Early Fieldwork in Mild/Moderate Disabilities, is one of the earliest courses taken in the program. The second course is the Differentiated Instruction and Collaboration Course, which students take midway through their program. Both general and special education teaching candidates take this course. Finally, at the end of the program, candidates enrolled in Student Teaching also participate in a variety of TeachLivE experiences. A description of the TeachLivE experiences for each course is included in these proceedings.

Early Fieldwork

The first course in which CSUN students become familiar with TeachLivE is SPED 403: Early Fieldwork in Mild/Moderate Disabilities. Before stepping into the TeachLivE lab, all students enrolled in the course set up a YouTube account. This enables each candidate to watch video of his or her interactions after the lab.
Students enrolled in the Early Fieldwork course go into the TeachLivE lab four times. The first time, the entire class comes in as a group. The course instructors introduce them to the system, and then each candidate is given three minutes to interact with the TeachLivE students in a “getting to know you” activity. After all candidates have had an opportunity to experience the system, the instructors lead a discussion about their initial experience, and answer questions.

The main focus of this class is to gain beginning competency in planning and delivering direct instruction. Students learn the nine-step explicit instructional format of Anita Archer (Archer & Hughes, 2011) to use in their fieldwork classrooms and the TeachLivE lab.

For the remaining three TeachLivE interactions in this course, the candidates are scheduled to attend in groups of five to six at a time. In the first of these three interactions they teach the Opening section of a lesson on the homophones their, there and they’re. Each candidate is given four to five minutes to gain student attention, review a previous skill (homophones to, two and too), and state the goal of the upcoming lesson (homophones their, there and they’re). For all of the TeachLivE interactions in the Early Fieldwork class, the simulator’s behavior levels are set very low (level 1) to allow for a focus on pedagogical skills.

In the next TeachLivE interaction, candidates prepare the first two steps of the Body of the lesson on the homophones their, there and they’re. They are required to teach the model (I Do It) and prompt (We Do It) steps, and each get five to eight minutes for this part of the lesson.

While candidates teach, the instructors and the other members of their group observe. Occasionally the instructor will stop the candidate and provide immediate feedback, which we refer to as real-time coaching, often in the form of questions. For example, instructors might ask, “What just happened?” “Did CJ answer your question?” or “Why do you think Sean is confused?” Peers are encouraged to join in the discussion and to suggest teaching strategies the candidate might try. Frequently the candidates jump back into the lesson and try again, and get the opportunity to restate a question or comment based on the coaching. After the candidates leave the lab, the videos of the interaction are edited in Camtasia so that the video of the candidate is side by side with that of the TeachLivE avatars. Candidates are required to view their YouTube video to reflect and learn from the experience, and submit a written reflection that includes what they observed and what they would like to do differently.

About two weeks after teaching the first two steps of the Body of the lesson, the candidates return to the lab for their fourth and final lab experience to reteach the same lesson. The intention is that they will have viewed their YouTube videos and used the feedback they received during their previous experience to revise the lesson. The format is generally the same as their third visit; candidates once again teach the model and prompt steps while the others in their group and the course instructors observe. The instructors will frequently pause the teaching to point out positive practices and improvements. Again, all interactions are videoed. As in the previous lessons, the candidates are required to view the new video and write a final reflection that discusses what differences occurred between their two experiences.

**Differentiated Instruction and Collaboration**

The second course in our program that uses TeachLivE is SPED 420: Improving the Learning of Students with Special Needs Through Differentiated Instruction and Collaboration.
This course is focused on evidence-based practices in inclusive education, and is taken by all the elementary, secondary, and special education teaching candidates in our university. In this TeachLivE experience, the candidates participate in a collaborative meeting with a resistant co-teacher, using the adult avatar Stacy Lewis.

Because these classes are quite a bit larger than our Early Fieldwork class (usually around 30 students), for this interaction we use a tag-team model. Students come in to the lab in groups of 10 – 15, and we randomly draw five names from a hat. Those five students are the only ones in their group who will actually interact in the simulator. The rest of the students in the group are charged with taking notes on the interaction, keeping a sharp focus on the goals of the interaction, and giving feedback to their colleagues throughout the interaction.

In the tag-team model, the five participants all “play” the same teacher. The class is given an extensive case study a week before the lab that explains the details of their interaction: “You are a first year general education math teacher, assigned to co-teach with a very experienced special education teacher, Stacy Lewis.” They are given a history of the co-teaching, which is not going well, as well as descriptions of the students in the classroom and the concerns about the efficacy of the co-teaching.

The first of the tag-team participants has to begin the meeting with Stacy Lewis. Stacy’s behavior level is set quite high (level 3), causing her to be very resistant to the conversation. After five minutes the next person in the team tags in and takes over the conversation, serving as the same teacher. The five group members proceed through the interaction in this way, with the last of the group tasked with winding up the conversation in a (hopefully) productive manner.

Throughout these simulations, the real-time coaching model is used to pause the interactions, discuss what is going well, and to debate potential directions for the conversation. All the class members in the room are encouraged to participate in these discussions. Students are prompted to consider everything they have learned about effective communication skills, listening skills, and frame of reference as they navigate this difficult interaction. As in the previous course, after the lab interaction the students watch a video and reflect on the experience.

**Student Teaching**

The final TeachLivE interactions occur in our culminating course, SPED 580MM: Student Teaching. Candidates in this course participate in three different TeachLivE simulations. In the first, they practice a parent conference using the same tag-team model as in the previous course. Again they are provided with an extensive case study of the situation, and the adult avatar is set to a Level 3 – the parent is not happy about the services her son is receiving. The second TeachLivE interaction is a model demonstration lesson, designed to be used for job interviews. In this lesson the students have nine minutes to teach an engaging direct instruction lesson on the topic of their choice, and the sessions are set up similarly to those in Early Fieldwork. The expectation is that the candidates will now be able to teach the lesson at a higher level of competency than in their previous TeachLivE experiences.

The final TeachLivE simulation is a discussion lesson. Since ours is a K-12 credential, we use the TeachLivE high school classroom for this interaction. Candidates work in groups to select a short article they feel would be engaging to high school students, and then each plan a
discussion lesson with three objectives: 1) to engage all the students in the discussion, 2) to use a variety of questions across the levels of Blooms Taxonomy, and 3) to guide students to an understanding of an essential Big Idea from the article. Candidates get five to eight minutes for this lesson.

What We Have Learned

Needless to say, we have learned a great deal over the three years we have used the TeachLivE system. First and foremost, we appreciate the fact that the TeachLivE experience allows our candidates opportunities to not only practice new skills, but to get immediate feedback and try again. This kind of immediate reflection and practice is not easy in a real classroom, and by “taking a redo” candidates can instantly see the effects of changes in their teaching practices. In addition, we feel the experience of watching their peers, who are at the same developmental level, practice the same skills with the same class of students, is invaluable. During the debrief at the end of every session the candidates report on what they’ve learned from watching their peers; the insights and confidence they gain from watching the strengths and challenges of their peers is a unique component that is only available through TeachLivE.

One complaint we sometimes get is that the candidates find it difficult to teach when they don’t have a relationship with the students. In addressing this complaint, we liken TeachLivE to a substitute-teaching model—although we cannot overestimate the importance of building relationships with students, a new teacher also needs to develop strong pedagogical skills, such as those they practice in the simulator. These skills allow them to productively teach kids even when they don’t have a relationship to fall back on, just as a good substitute teacher does.

Another important takeaway has been the need to increase our focus on positive feedback across all of our experiences. In our eagerness to improve our candidates’ teaching skills, it becomes all too easy to focus only on those skills they need to improve, at the expense of identifying and celebrating those that they have already mastered. Just like K-12 students, our university students need to identify and build on their own strengths, and TeachLivE is a wonderful venue in which that can occur.

Data

We are working to improve our data collection to measure the impact of TeachLivE in all of our courses. In Spring 2015 we conducted a pilot study to measure the outcomes of the interactions in two sections of SPED 420, Differentiation and Collaboration. Students in one section of the course completed the TeachLivE simulation; students in the other section completed the same interaction (using the same materials), but did so in a traditional role-play activity in class. Afterwards, they were asked to rate themselves on a 4-point Likert scale on three measures: 1) This activity helped me learn to apply effective communication skills, 2) This activity helped me gain new insights into working with colleagues, including co-teachers, and 3) This activity gave me new insights related to frame of reference. In each case, the TeachLivE group scored marginally higher than the role-play group on all measures (see graph on the following page).
Final Thoughts

Every semester we fine-tune and try new ideas for using TeachLivE. We have learned that we need to thoughtfully balance the groups coming into the lab so that each group has some strong role models to “set the bar” for the others in their group. By having a balance of very proficient and less proficient candidates in each group, students can learn from their peers which practices are most effective and which to avoid.

Additionally, we’ve learned that the group process of observing, brainstorming and reflecting is one of the most valuable components of the TeachLivE experience, and one that can’t be replicated in a typical fieldwork experience. Although some students are less receptive to the experience than others, we have been able to observe growth in instructional skills across the experiences in individual courses, as well as across the continuum of courses in our program. Increasing the focus on positive feedback makes students receptive to the real-time coaching model used in TeachLivE.

Finally, TeachLivE provides our candidates with a unique opportunity to practice collaborative and communication skills that are not often addressed in teacher education programs. We feel that the developmental continuum of TeachLivE experiences across the body of our program adds a beneficial layer of practice and reflection not previously available to our candidates.

References


Microcredential: 4:1 Positive Praise Strategy

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Abstract

Teacher skills and behaviors (e.g., pedagogy, classroom management, asking open-ended questions) impact student learning, and should be continually honed and sharpened over a teacher’s career. Microcredentialing is the process of identifying and providing targeted professional development on specific skills and behaviors to improve student outcomes. In this study, participants ($N = 21$) were divided into two groups: the treatment group ($n = 15$) completed a pretest, a microcredentialing intervention, and posttest, and the control group ($n = 6$) completed a pretest and posttest. Researchers hypothesize the treatment group scores on the posttest will show statistically significant gains. Successful completion of the microcredential is a mean ratio of four positive praises to every one criticism. Data analysis is ongoing.

Literature Review

Classroom management is meant to provide students with a structured learning environment that enhances motivation, knowledge, and attitudes. Developing and implementing strategies takes practice and determination that is often difficult for beginning teachers but easy for experts (Shulman, 1987). Implemented correctly, professional development can help novice and expert teachers refine classroom management skills for a positive learning environment.

Positive praise is defined as the use of verbalizing direct, specific, positive feedback to students immediately after a desired behavior is observed (Bayat, 2011; Musti-Rao & Haydon, 2011; Simonsen et al., 2010). Using praise in the school setting is a skill that needs practice, and mastery comes with time (Simonsen et al., 2010). Students often behave in a random manner when they are young, repeating behaviors that get attention or a desired reaction (Sigler & Aamidor, 2005). When praise is not connected to desired behaviors or is seen as meaningless in the students’ eyes, it loses its efficiency and has the opposite of the desired effect (Bayat, 2011). Bayat (2011) and Musti-Rao (2011) describe six ways teachers can praise students in the classroom: (1) describe the students’ behaviors; (2) make the praise public to help encourage the rest of the students in the classroom; (3) use best judgment in who to praise and why praise is given; (4) delay responding to negative behaviors directly after they happen to avoid giving attention to those behaviors; (5) use phrases to acknowledge desired behaviors; (6) add value judgments to the praise. When praise is used appropriately and specifically, student morale and academic engagement increase (Bayat, 2011; Chalk and Bizo, 2004).

In a research study, Becker, Engelmann, and Thomas (1975) report off-task behavior increased from 25.5% to 31.2% with over 50% off-task behavior on some days when criticism increased. Too much criticism on the teacher’s part does not necessarily stop, and can actually increase, a student’s inappropriate actions. In a later study, Pfiffner, Rosén, and O’Leary (1985) discovered that teachers’ use of all positive praise without criticisms in the classroom was ineffective at curbing students’ off-task behavior. The researchers also found that academics
suffered when teachers used only positive praise techniques. Since positive praise could not
decrease off-task behavior in the classroom (Pfiffner et al., 1985) and negative behaviors
increased for students who only received criticism in the classroom (Becker et al., 1975), a
classroom needs a balance of positive praise and criticisms.

Myers et al. (2011) researched four teachers’ use of professional development focused on
implementing a 4:1 ratio of positive praise to criticisms. The researchers were interested in
student engagement in classroom activities when the ratio of positive to negative praise was at
least 4:1 compared to when the ratio was less. Myers et al. hypothesized that teachers
implementing a 4:1 ratio in positive praise to criticisms would see a decrease in off-task student
behavior and an increase in student engagement and learning outcomes. At the completion of the
study the researchers suggested that there was an “overall downward trend in student problem
behavior...in each teacher’s classroom during the course of the intervention” (p. 51) and that
students were academically engaged in the lessons. The teachers also stated that the students
reacted well to the use of positive praise comments.

In a similar study, Rathel et al. (2014) studied four teachers’ implementation of praise
strategy in the classroom. The researchers found that ratios for teachers’ positive comments to
criticisms during the baseline phase were almost 1:1, with two of the teachers giving more
criticisms than positive comments during their class. After an intervention that involved a
meeting with each teacher, observations, and coaching in positive-praise strategies, all teachers
substantially raised their ratios of positive praise to criticisms, with all but one teacher reaching a
ratio of 5:1 in subsequent observations.

The 4:1 positive praise strategy has proven effective in curbing students’ off-task
behaviors, increasing academic engagement, and increasing student motivation (Musti-Rao &
Haydon, 2011; Myers et al., 2011; Rathel et al., 2014). Praise has been shown to make students
feel accepted and increase their self-esteem, and to improve teacher-student relationships by
establishing a positive, more productive learning space (Musti-Rao & Haydon, 2011).

This study will be used to implement professional development with several meetings
and use of a virtual simulator (TeachLivE™) geared toward instructing teachers to increase their
positive praise in the classroom while minimizing the criticisms to obtain a ratio of 4:1 positive
praise to criticisms. The 4:1 praise technique has proven to help teachers increase classroom
management skills and decrease off-task behavior (Myers et al., 2011). Virtual simulators have
been engineered to help pre-service and in-service teachers strengthen skills used in the
classroom through deliberate practice (e.g., Sawchuk, 2011; Andrade et al., 2010; Ericsson et al.,
1993). For this reason, it is important to research whether or not participants can demonstrate
mastery of specific teaching skills through use of a virtual simulator, reflection, and direction,
and implement strategies in the classroom. Teachers that are able to successfully obtain this ratio
will be awarded with a microcredential badge in positive praise. Microcredentials are skill-
based, stackable competencies that show personalized learning used by teachers to demonstrate
This type of competency is relatively new to the educational field and can help establish teachers
with mastery skills in several areas of pedagogy.
The purpose of this microcredential is to aid teachers in successfully eliminating off-task behavior with the 4:1 positive praise strategy (Myers, Simonsen, & Sugai, 2011; Rathel, Drasgow, Brown, & Marshall, 2014) to help increase student learning outcomes in a positive environment. Training alone does not necessarily result in a consistent increase in teachers’ use of professional development, thus practice in the learned area must be observed and researched to determine its effectiveness in the teacher’s daily instruction and classroom management skills (Musti-Rao & Haydon, 2011; Simonsen, Myers, & DeLuca, 2010).

Methods

Research Questions

Research Question 1: Do participants earning a microcredential increase their ratio of positive praise to criticism in the TeachLivE simulator?

Research Question 2: Will there be a statistically significant difference in pretest/posttest scores between the treatment and control groups?

Hypothesis

The null hypothesis for Research Question 1 is that participants in the treatment group will not show an increase in their ratio of positive praise to criticism using the TeachLivE simulator. The alternative hypothesis for Research Question 1 is that there will be a significant increase in the ratio of positive praise to criticism for participants in the TeachLivE simulator.

The null hypothesis for Research Question 2 is that there will not be a significant mean difference in pretest/posttest scores between the treatment and control groups. The alternative hypothesis for Research Question 2 is that there will be a significant difference in pretest/posttest scores between the treatment and control groups.

Research Design

This study used a quasi-experimental non-equivalent control group design. Two non-equivalent groups received either a pretest, microcredentialing intervention using TeachLivE, and posttest (treatment group), or only a pretest and posttest (control group). According to Gall, Gall, and Borg (2006), in non-equivalent group design, “research participants are not randomly assigned to the experimental and control groups, and both groups take a pretest and posttest” (p. 416). This study involved two groups of college students, with intervention (i.e., TeachLivE) for the treatment group only.

Participants

This study used convenience sampling; participants (N = 21) were students with a variety of academic foci in a substitute teaching class at the University of Central Florida. They volunteered to take part in the study, and were divided into two groups. The treatment group (n = 15) completed a pretest, microcredentialing intervention, and posttest; the control group (n = 6) completed a pretest and posttest. There were no restrictions as to education level, age, or area of study.
**Instrumentation.** A Qualtrics survey was created to assess the participants’ knowledge of praise before and after the microcredential intervention. The survey consisted of demographic information and classroom praise/criticism scenarios in the form of 16 multiple-choice questions.

TeachLivE was the treatment device and dependent variable within the study. Findings indicate that four 10-minute sessions in the simulator can effectively change teacher practices that are reflected in the actual classroom (Straub, Dieker, Hynes, & Hughes, 2014). TeachLivE is a mixed-reality simulator that allows participants to work with five avatars in a middle school or high school classroom. Avatars can respond to prompts and questions in real time.

**Data Collection.** Both the control and treatment groups were asked to complete the Qualtrics pretest before the study and posttest at the end of the study. Participants in the treatment group were asked to complete the 4:1 Praise Microcredential, which consisted of two overview questions, three 4-minute TeachLivE sessions consisting of a baseline session and two sessions with feedback, and a reflection. During the TeachLivE sessions, two inter-raters scored numbers of positive praise and reprimands. The inter-raters gave feedback to the participants after each session.

**Data Analysis**

Data is currently being collected. Results are expected at the end of summer 2015. We will use a dependent $t$ test to answer Research Question 1: Do participants earning a microcredential increase their ratio of positive praise to criticism in the TeachLivE simulator? We will use independent $t$ test to answer Research Question 2: Will there be a statistically significant difference in pretest/posttest scores between the treatment and control groups?

**Limitations**

Validity. Feedback given to participants in between sessions could reflect experimenter bias. Inter-raters gave feedback to direct and educate the participants after each session. The instrumentation for the pretest and posttest was created by the researchers and administered through Qualtrics. The instrument was not validated and thus creates a threat to internal validity.

The Hawthorne Effect was a limitation; participants knew they were in an experiment and their mannerisms would have changed (Gall, Gall, & Borg, 2007). Participants received attention from researchers in the form of feedback. The posttest was approximately three weeks after the pretest, potentially creating posttest sensitization. Pretest and posttest questions were the same in each. It would be difficult to generalize results to the public due to a small sample size.

Participant attrition occurred for unknown reasons. Twenty-one participants began the study in the treatment group, completing the pretest and TeachLivE sessions. Only fifteen participants in the treatment group completed the posttest survey. The control group had ($n = 12$) participants take the pretest, but only six completed the posttest.

**Future Research**

The researchers would like to extend the study to in-service teachers and include classroom observations before and after the 4:1 microcredential. By extending the study to in-
service teachers, the researchers will be able to evaluate the differences in classroom management skill level between novice and professional. The addition of the classroom observation will allow researchers to determine any increase in the positive praise ratio between pre- and post-observations, as well as the longevity of impact of the microcredential.

References


Video Recording Instructional Coaching: An Effective Strategy to Improve Teaching

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Introduction

Direct and purposeful feedback is essential for improving the art of teaching, yet how much time do teachers practice and receive feedback? With the shift to the Common Core Standards, rigorous, engaging, and applicable professional development for teachers is paramount. The flaws in the current professional development models include one-time presentations, one-size-fits-all applications, and the absence of robust dialogue with teachers about their pedagogy.

Three years ago, we implemented a video recording instructional coaching model. The purpose of this presentation is to share our work recording instructional coaching and how it is becoming an effective strategy to improve teaching.

Method

For the purpose of supporting video recording instructional coaching, it is important to understand the meaning of instructional coaching. The purpose of an instructional coach is to “coach” a teacher, providing feedback anchored in research-based instructional strategies to improve his or her craft. The modeling of strategies between instructional coach and teacher makes this unique compared to other coaching approaches.

In this variation, a teacher discusses a lesson plan with the coach prior to a recording session. Then the teacher is recorded during a regular class period. The video is provided on an online technology platform at a confidential site that is available only to the teacher and to the coach. Both view the recording and make notes as needed. In this model, the teacher and coach are asked to show where they glow and where they may need to grow. The coach and teacher then view the performance together. The teacher and coach discuss the lesson with a specific focus on what and how to improve.

Jim Knight (2007) stated:

A good coach is an excellent teacher, and is kind hearted, respectful, patient, compassionate, and honest. A good coach has high expectation and provides the affirmative and honest feedback that helps people to realize those expectations. A good coach can see something special in you that you didn’t know was there and help you make that something special part of you. This is the kind of coach we have in mind when we use the term instructional coach. (p. 218)

Video recording instructional coaching is anchored in the concept of three specific categories of teaching: behavior, instructional strategies, and formative assessment.

Byron-Bergen’s approach to using video recording instructional coaching provides expert, confidential, non-evaluative, one-to-one support to participating teachers. In addition to
Individual coaching, the program offers introductory sessions that show participants what instructional coaching looks like through role-playing and model lessons. The Byron-Bergen Central School District believes that every teacher can get better; this is not just for new teachers or highly effective teachers. No matter where a teacher falls on the effectiveness scale, he or she can be better. Our goal is to have every teacher in the district experience instructional coaching within the next three years.

To this date, 29 teachers on the Byron-Bergen staff have participated in a cycle of coaching. Since this is a confidential model and the district does not want to jeopardize the work that has been completed, we elected to speak to just one teacher to gather qualitative data. Elayna Reed is a fifth grade teacher who has been teaching for four years, the last two at Byron-Bergen Elementary School. Elayna provided the following feedback in regards to her experience with Video Recording Instructional Coaching:

When I first heard about the program, I was immediately intrigued. I became a teacher because of my passion for lifelong learning. I constantly push myself to be better, and I expect the same from my students. So this was an opportunity to walk the walk. In college, I was required to videotape my lessons. It made sense to take an in-depth look into my effectiveness; however, it never occurred to me to continue this practice once I had a classroom of my own. I learned so much in my initial brief meeting with our Video Recording Instructional Coach. He really connected and put himself on my level. We were both in it for the same reason: to improve the learning experience for the kids by growing my expertise. I loved that only our video recording instructional coach and I ever saw the video. We watched it separately and together and then discussed it. The coach guided me toward thinking in-depth about my goals, successes, and ways to further extend my students. We would share experiences and strategies, and discuss what methods could be used to achieve my objectives and become more creative. He threw the idea of journaling as a teaching tool out there, and I researched and ran with it. Creating a journal helps students understand concept by illustrating them with drawings and real-world demonstrations. It’s been a great addition to my teaching style. I used to leave my classroom thinking, “I wish I did this differently.” Now I leave with a heightened awareness of my how effective I was. I have a greater sense of fulfillment. This experience has inspired me to be better than I was the day before, not just on good days, but every day. I’ve always been a reflective teacher, but now I reflect at a much higher level. This is what 21st century professional development should look like: interactive, supportive, and reflective. Every teacher should be doing this. Everyone wants more professional development opportunities. But there are very few with such immediate, effective takeaways. (Interview 4/13/14)

The process of implementing Video Recording Instructional Coaching has had its peaks and valleys. As we reflect on the implementation and impact of this professional development opportunity for our teachers, we understand that partnership communication and trust are
essential for its success. With teaching, we always aim for those magical moments where everything comes together. By Elayna Reed’s second video recording session, her entire lesson was a magic moment. That is what we are working toward achieving for all our teachers.

Video recording instructional coaching is about helping teachers build better relationships with individual students by responding to each child’s learning style. As more teachers benefit from video recording instructional coaching and share the experience with their peers, we expect the demand for the program will increase.

In conclusion, professional development in education has gotten a negative reputation, and possibly for good reason. Trainings are often one-time, sporadic opportunities and do not provide sustainable techniques for improvement. It is apparent that teachers who have participated in video recording instructional coaching believe it is an effective strategy to improve teaching because it is ongoing, it is conducted in an environment of trust that encourages risk taking, and it provides concrete feedback and strategies that instructors can implement immediately in the effort to improve their art and craft of teaching. One of the most promising tools today for any educator who wants to be a better, more effective teacher is video recording instructional coaching.

References

Utilizing TeachLivE As a Component of a Multi-Tiered Approach to Preservice Teacher Preparation

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Abstract

It is important to continue to document and investigate effective processes for developing teaching behaviors and reflection in preservice teachers. The primary objective of this paper was to document the evolution of TeachLivE™ within a preparation program for special education majors, and to determine the effectiveness of a multi-tiered investigation utilizing the trifecta model of preparation: TeachLivE™, student self-reflections, and multiple means of feedback. As an early TeachLivE™ beta site, this technology has been used across the special education program at Western Michigan University. Its uses include providing (a) opportunities for special education majors to practice effective teaching skills incorporated into the practicum and/or internship settings, (b) opportunities for pre-interns and interns to focus on specific teaching skills in need of further development, and (c) remediation for pre-interns and interns displaying a need for more intensive coaching and focused attention on specific teaching skills.

Background

Typically, multi-tiered instruction in the context of teacher preparation accompanies an emphasis on developing the capacities of preservice teachers to implement RTI and provide services within a multi-tiered system of support (Harvey, Yssel, & Jones, 2014; Prasse et al., 2012; Brownell, Sindelar, & Kiely, 2010). However, the literature lacks the incorporation of RTI strategies and use of a multi-tiered system of support in preservice teacher preparation programs. The Special Education program at Western Michigan University began incorporating a variety of methods to develop effective teaching skills during the 2009-2010 school year.

A small team of faculty researchers launched a research program to determine the benefit of multiple techniques across various learning contexts within the program. As the research team developed a plan for the most effective uses of TeachLivE™ within the special education program, its use evolved into a multi-tiered system of preservice teacher development (across academic years in the program) and support (within each year of the program). The Special Education program at WMU is a five years, including one full year (two semesters) of internship.

The first two years of this program focus on general education requirements. In the third year of the program, students begin their special education coursework. Within this multi-tiered structure, particular courses in the third and fourth years were deemed appropriate for incorporating the use of various technologies for skill development. Further development and support are provided during the fifth and final year if necessary. See Table 1 for a representation of the implementation of TeachLivE™ across the courses.

Implementation

An early series of studies sought to increase the quality of preservice special education teachers with a Trifecta model of preparation (Whitten & Wallace, 2014; Whitten, Enicks, Wallace, & Morgan, 2013). The Trifecta model began with an emphasis on (1) the use of IRIS...
modules, (2) TeachLivE™, and (3) in-action coaching using bug-in-the-ear (BIE). During the first Fall semester of implementation, students in SPED 4340 (Curriculum and Instruction in Special Education) and SPED 4850 (Education of Learners with Learning Disabilities) were randomly assigned to the TeachLivE™ group or to the IRIS modules group. Each student taught approximately seven-minutes per TeachLivE™ session.

Because the TeachLivE™ sessions were scheduled during regular class time, half of the class participated in TeachLivE™ while the other half completed related IRIS modules. IRIS modules were chosen as an alternative to TeachLivE™ because of their availability, the allowance of student exposure to similar content, and because they were addressed during the TeachLivE™ sessions. BIE was reserved for use in the practicum setting for both classes. In an effort to ensure both experiences for all students, those who participated in TeachLivE™ in the fall completed IRIS modules in the spring and vice versa.

During the second fall semester of implementation, all students enrolled in SPED 4340 (Curriculum and Instruction in Special Education) and SPED 4850 (Education of Learners with Learning Disabilities), plus all first-year students enrolled in SPED 3310 (Classroom Practicum in Special Education) participated in TeachLivE™. The first-year students enrolled in SPED 3310 used TeachLivE™ to develop discrete, evidence-based teaching skills related to interaction with students. Skills included: use of behavior specific praise (Brophy, 1981), use of command statements versus requests, providing opportunities to respond (Partin et al., 2009; Stichter et al., 2008; Sutherland & Wehby, 2001), and error correction strategies (Drevno et al., 1994). Consistent with the teaching and application process for second-year students, first-year students learned about each of these skills in class and applied them in the TeachLivE™ classroom.

For second year students enrolled in SPED 4340 (Curriculum and Instruction in Special Education) and SPED 4850 (Education of Learners with Learning Disabilities), the TeachLivE experience was front-loaded so that students learned and practiced effective teaching skills prior to entering practicum placements. Teaching skills included: (a) positive specific praise – whole group and individual (Brophy, 1981; Mueller & Dweck, 1998; Glazer, 2007), (b) higher order thinking and questioning (Lewis & Smith, 1993), and (c) wait time (Tobin, 1987). At least one follow-up session was scheduled toward the end of the semester to measure maintenance of skills in the TeachLivE™ environment. Students received repeated opportunities to practice essential skills for their level in the program in TeachLivE™, and received immediate feedback following their sessions. If students struggled to develop certain skills, either pre-session or in-session coaching was provided to increase student fluency in the targeted skills.

The faculty research team then began to consider ways in which TeachLivE™ could be meaningfully implemented during the Spring semester for the second-year students enrolled in either SPED 4340 (Curriculum and Instruction in Special Education) or SPED 4850 (Education of Learners with Learning Disabilities). First-year students completed another block of coursework that did not include TeachLivE™. TeachLivE™ and IRIS modules were then used as a part of a Tier 2 intervention to address deficit areas in the preservice special educators who participated in TeachLivE™ in the Fall semester in either SPED 4340 or SPED 4850 and displayed a need for additional opportunities to practice key skills. Students were selected to receive the Tier 2 supports based on their performances during the initial teaching observation during the spring practicum. The idea behind the Tier 2 implementation was to determine how well the
students carried over the skills from the fall to spring semesters. Students not selected to receive Tier 2 supports using TeachLivE accessed IRIS modules as an alternative learning opportunity.

TeachLivE has also been used as a Tier 3 intervention for students struggling in internship teaching experiences (SPED 4760 or SPED 4770) and who need additional practice teaching in a simulated environment. Typically, the students utilizing TeachLivE at the Tier 3 level received evaluations including multiple below average ratings that would require immediate action to resolve. TeachLivE sessions at this level are highly individualized, one-on-one in-action coaching experiences that may last anywhere from 30 minutes to an hour per session. Along the Tier 3 spectrum, BIE has also been utilized for students in need of in-action coaching during the school-based intern teaching experience.

Impact on Student Performance

According to participating students, as the series of fall investigations progressed, the most effectual elements were (a) the pre and post self-evaluations measuring preparedness and performance before and immediately after each TeachLivE and practicum session, (b) feedback/in-action coaching during TeachLivE, and (c) the actual use of TeachLivE at the Tier 1 level, where all students participated in TeachLivE to practice specific skills.

Overall reactions to TeachLivE™

According to a recent survey of pre-intern and intern students (n=58), 72% of students noted TeachLivE had a direct impact on their teaching practices. Specifically, TeachLivE positively effected (a) comfort levels in front of the classroom, (b) application of practice in the practicum and internship placement, (c) classroom management skills, and (d) preparation to address classroom diversity. Students noted that TeachLivE caused them to be more conscious of the statements they made in their classrooms and more intentional in the language they used. For example, instead of asking “Can you . . .”, a more frequent use of command statements helped students be more direct during their interactions in class. One preservice teacher noted, “I feel it really helps to develop a teacher’s teaching style and behavior.”

Pre/post self-evaluations. The pre/post self-evaluations are 10-question abbreviated versions of the Assessing Teaching Effectiveness (ATE) tool used during direct observations, and were completed prior to and immediately following each TeachLivE and practicum session. The selected ATE questions were based on the skills prioritized for the TeachLivE sessions, such as: utilizing attention signals (bringing a class together); establishing expectations; developing the rhythm of lesson plan progression (“I do, We do, You do”; Levy, 2007); praise and correction; opportunities to respond; specific praise (social and academic); higher order thinking/questioning (whole group and individual); wait time. Students were also asked to complete a written reflection of the classroom participation/learning and their own teaching. The frequency count tally boxes were added in an effort to display change over time and to allow the students to monitor their progress across TeachLivE sessions and compare their performances in their practicum settings. See Figure 1 for an example of the pre/post self-evaluation form used.

Students noted how pleased they were to able to track their own progress and data. One noted, “I was very happy to see as the semester [progressed] my lines increased. I think I still need to work on [one essential skill]. The idea is still fresh though, and I look forward to working
on it.” The ability to quantify, track, and analyze their scores allowed them to make decisions about their own professional practice. Another student reflected, “Based upon the given graph, I have maintained a slightly positive trend line for my overall reflection of professional practice. While the pre-reflection scores . . . dips around mid-October, the data is consistently [high]. On the other hand, the post-reflection scores [represent] . . . a positive trend.”

**In-action coaching/feedback.** Throughout the TeachLivE sessions, students received in-action coaching, verbal feedback following the session, and written feedback on the abbreviated ATE. As students taught, if there was an area that needed to be addressed immediately, either the professor or the student would simply ask to “pause classroom” for a coaching session. Afterward, the professor would “resume classroom” and the skill could be demonstrated again until both the student and the professor felt the execution was proficient. After the student’s lesson, there would typically be a brief interaction with general feedback or processing as a form of closure. The student would also receive written feedback within 24 hours of the session.

Students noted benefits of the in-action coaching and feedback from the TeachLivE sessions. The ability to stop, hear feedback, and try again appealed to the majority. One student shared, “TeachLivE is a safe environment in which you are able to receive immediate, corrective feedback from professors.” Students also voiced an appreciation for immediate transferability to the practicum and internship placement. Another student noted, “The practice and feedback that I gained during TeachLivE experiences transferred to my teaching in my practicums and internship, and vice versa. I think that the feedback given during TeachLivE and from my direct observations was the most helpful and made the biggest, long-lasting affect on my teaching.”

**Participation in TeachLivE at the Tier 1 level.** Our incorporation of TeachLivE has been refined since its introduction to the program; early on, there was some overlap in skills taught, but now there is greater distinction between skills at an initial level of exposure and those that are being reinforced. TeachLivE serves as an opportunity for skill development and maintenance, and constant student feedback has allowed us to make the experience even more meaningful to the students. One student said: “I’ve been able to see a great deal of good with the early uses of TeachLivE, specifically when I was just beginning to get into real classrooms. The TeachLivE uses during that time were nice as I was able to practice new skills and be critiqued on them as well. It was nice to be able to use TeachLivE in the second year of my program, but I don’t feel it as necessary.” As students noticed a level of redundancy in some skill areas, we also recognized a need for greater differentiation, especially as we took into consideration the varied levels of skill development. Many students also noted the benefit of practice in a teaching environment with a population with which many of them had limited experience. “I thought TeachLivE was very beneficial when we were in the middle school setting because the students in TeachLivE were the same age. I was able to practice and redo things in TeachLivE whereas I would not have been able to when actually teaching a classroom. I thought it was very helpful.”

**Discussion**

As preservice Special Education teachers practice and develop essential teaching skills, TeachLivE has a positive impact on their overall perception of skill development and execution. Specifically, coaching, feedback, and reflection were cited as having significant impact on their classroom behaviors in relation to their experience developing each of the essential skills. Preservice teachers found a benefit in exposure to TeachLivE at specific points throughout their
program, as it allowed opportunities for self-evaluation and self-monitoring progress. They found the most benefit in scaffolded instruction built upon current learning.

Incorporation of TeachLivE into a multi-tiered system of preservice teacher development can be generalized to other teaching or related service provider programs. Our process of development, though organized and carefully developed, was still a trial and error process as we worked to meaningfully incorporate TeachLivE into our program. The flexibility provided by a mixed-reality, virtual environment such as TeachLivE allows us to individualize the teacher preparation process at levels not previously feasible.

Further development of this work will include a quantitative analysis of (a) the pre/post self-evaluation scores to measure change over the course of the semester and (b) a comparison between the pre/post self-evaluation scores, the TeachLivE observation scores, and the practicum direct observation scores. Utilizing this next level of analysis will provide a more comprehensive picture of TeachLivE’s impact in a multi-tiered approach to preparing preservice Special Education teachers.

References


Table 1. Multi-Tiered System of Preservice Teacher Development using TeachLivETM

<table>
<thead>
<tr>
<th>Tier 1</th>
<th>Essential Skill Development</th>
<th>Course</th>
<th>SPED 3310</th>
<th>Classroom Practicum in Special Education</th>
<th>SPED 4340</th>
<th>Curriculum and Instruction in Special Education</th>
<th>SPED 4850</th>
<th>Education of Learners with Learning Disabilities</th>
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<tr>
<td>Tier 2</td>
<td>Targeted Skill Development</td>
<td>Course</td>
<td>SPED 4340</td>
<td>Curriculum and Instruction in Special Education</td>
<td>SPED 4850</td>
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<td>Tier 3</td>
<td>Targeted Skill Remediation</td>
<td>Course</td>
<td>SPED 4760</td>
<td>Intern Teaching in Special Education: LD</td>
<td>SPED 4770</td>
<td>Intern Teaching in Special Education: EI</td>
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- Essential skills are evidence-based and known to support effective instruction and produce higher student outcomes (i.e., specific praise, wait time, higher order questioning).
- Targeted skills are skills still in need of development, following two or more semesters of implementation in a practicum setting.
- Targeted skill remediation is a more intensive focus on skill deficit areas, based on individual needs, and occurs outside of the regularly scheduled class time.

Figure 1: Abbreviated ATE with Frequency Count Boxes

Pre/Post

Western Michigan University
Department of Special Education and Literacy Studies
Abbreviated Assessing Teacher Effectiveness

Student Name:   Course:  
Observation Date:  Observation #  Observer Name:  

<table>
<thead>
<tr>
<th>Meets Expectations (ME)</th>
<th>Progressing Towards Expectations (PTE)</th>
<th>Focus Attention Needed (FAN)</th>
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<tr>
<td>5 4 3 2 1 0</td>
<td>Very good Good Average Poor Very Poor Not Present</td>
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Comments:

1. **Gains student attention prior to instruction.** *(CEC 5)*

   5 4 3 2 1 0  

2. **Clear expectations are established.** *(CEC 5)*

   5 4 3 2 1 0  

3. **Demonstrates congruence between the lesson plan and instruction while incorporating student responses to the lesson.** *(CEC 3, 4, 5)*

   5 4 3 2 1 0  

4. **Provides explicit reinforcement to student responses.** *(CEC 4, 5)*
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5. Provides opportunities for student responses. (CEC,4)

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Positive Specific Praise Tally:  
HOQ:  
Wait time:  

6. Maintains active student engagement through meaningful and motivating lessons. (CEC 4, 5)

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7. Plans for student diversity through differentiation of individual needs. (CEC 3, 4, 5, 7)

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8. Embeds authentic assessment in lessons including on-going progress monitoring. (CEC 8)

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9. Provides consistent routines and procedures for managing all class activities. (CEC 4, 5, 7)

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10. Effectively paces instruction. (CEC 4)

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**Summative Evaluation of Students:** How did the students perform/Did they achieve planned objectives?

**Summative Evaluation of Lesson:** (Teacher’s reflection) How did your lesson go? What changes (if any) would you make?

Positive Specific Praise Tally:  
HOQ:  
Wait time:  

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48
TeachLivE National Research Project

Year 2 Findings

University of Central Florida
Carrie Straub, Ph.D.
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Michael Hynes, Ph.D.
Charles Hughes, Ph.D.
Using Virtual Rehearsal in TLE TeachLivE™ Mixed Reality Classroom Simulator to Determine the Effects on the Performance of Science Teachers: A Follow-up Study (Year 2)

This research project was supported by funding from the Bill & Melinda Gates Foundation.

Abstract

A follow-up study, Phase II, was conducted to mirror procedures from Phase I of a quasi-experimental, pre-post group design examining the effects of repeated virtual rehearsal sessions in a mixed-reality computer simulated environment, the TLE TeachLivE™ (TeachLivE) classroom simulator (see Straub, Dieker, Hynes, & Hughes, 2014). In the first phase, 157 middle school mathematics teachers across the nation received four levels of innovative professional development, including computer simulation, synchronous online instruction, and lesson resources based on the Common Core Standards (CCSS). The researchers found that four 10-minute sessions in the TeachLivE simulator improved targeted teaching behaviors in the simulator, and that those improvements transferred into the teachers’ classroom settings.

In Phase II, the research team used refined methods to examine the effects of four 10-minute sessions of 129 secondary science teachers working with newly developed high school avatars to compare two levels of professional development, lesson resources, and these same resources combined with virtual rehearsal in TeachLivE. Phase II teachers who took part in TeachLivE significantly increased their targeted behaviors compared to colleagues who did not take part in computer simulation, and again, as in the Phase I study, the results transferred back to their real classroom settings. Results from both Phase I and Phase II research validate that, in the field of teacher education and simulation, professional learning in mixed-reality simulated classrooms can be effective in positively impacting teacher practice.
Using Virtual Rehearsal in TLE TeachLivE™ Mixed Reality Classroom Simulator to Determine the Effects on the Performance of Science Teachers: A Follow-Up Study

The current administration has invested billions of dollars in education reform, and changes are underway. In the White House’s 2011 *Strategy for American Innovation*, authors addressed the need for better teacher preparation in science, technology engineering, and mathematics (STEM) subjects (National Economic Council, Council of Economic Advisers, and Office of Science and Technology Policy, 2011). Though student scores on the National Assessment of Educational Progress (NAEP) are improving in eighth grade, only 32% of eighth grade students reached or exceeded proficiency in science in 2011 (National Center for Education Statistics, 2011). The Common Core Standards Initiative (2011) aimed to increase content knowledge with the expectation that students will take on greater challenges in their academic careers and be better prepared for their careers or college coursework. While raising expectations for students, this shift in standards has also altered the way teachers are expected to approach education, by moving to an increasingly student-centered, inquiry-based approach to learning, where students are engaged with “deep learning goals enabled by new pedagogies and accelerated by technology” (Fullan & Langworthy, 2013, p. 4). This need for deeper learning is reinforced in the National Research Council (NRC) Framework and Next Generation Science Standards (NGSS) underscoring the importance of students’ thorough understanding of core scientific ideas and the ability to discuss their ideas with others (Reiser, Berland, & Kenyon, 2012). These shifts in student expectations require a corresponding shift in teacher professional development. Teacher preparation programs need to prepare teachers for these new standards, but in-practice teachers need immediate retooling to prepare students to meet standards designed to result in better college and career options upon graduation. If teachers must undergo rigorous professional development (PD) to be ready to teach these standards, their training must be efficient and immediate with strong transference of knowledge (Windschitl, Thompson, Braaten, & Stroupe, 2012) to give students a quality understanding of these new standards in practice.

Reform in science instruction, beginning in the 1960s, has increased interest in a new scientific inquiry-focused teaching approach that can be traced through the *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993), the *National Science Education Standards* (National Research Council [NRC], 1996), and *Inquiry and the National Science Education Standards* (NRC, 2000). The underlying philosophy is that “science practice involves doing something and learning something in such a way that the doing and learning cannot really be separated.” The word *practice* becomes the operative word, a skill to be honed, much like riding a bike (Michaels, Shouse, & Schweingruber 2008, p. 34). In inquiry-based science, students are encouraged to take a hands-on, investigative approach to learning the functions of scientific concepts (Duschl, Schweingruber, & Shouse, 2007; Shouse & Schweingruber, 2008). Bybee (2002) indicates that students significantly improve cognitive understanding of the field of science with inquiry-based methods. Yet most science classroom discussions follow a pattern of initiation, response, and evaluation (I-R-E) most commonly linked to elementary class structure, but clearly observable throughout primary and secondary schools and even at the college level (Neal, 2008). The pattern is easy to recognize: the instructor asks a question, usually one to which he or she already knows the answer; the student responds, and subsequently receives feedback or constructive criticism. Instructors use this pattern for various purposes – to remind students of information, spark a discussion, etc. (Neal, 2008).
The Common Core Standards point to a departure from this structure to explore problems and ideas that, in the IRE pattern, might not see the light of day (National Science Teachers Association, 2014; Waring, 2009). Furthermore, the exploration of potential learning outside of the structure places the students’ education squarely in their hands, piquing their curiosity as they are able to practice discovering new knowledge on their own (Goodwin, 2007; Hawkins, 2007; Walsh, 2002; Waring, 2009). The NRC Framework and NGSS focus not so much on memorization of facts on the scientific process but on a thorough understanding of core scientific ideas and the ability to discuss them with others (Reiser, Berland, & Kenyon, 2012). The transition from the typical IRE pattern to a more challenging and far-reaching exploration of science will require a conscious effort by teachers directing student discourse, so that students can make sense of the material constructively (Bacolor, Cook-Endres, Lee, & Allen, 2014).

Retooling Teachers

To engage students at new levels of thinking in science, teachers need to demonstrate an array of teaching practices in their classrooms, and PD should target the practices teachers find most challenging (Windschitl et al., 2012). In the Measures of Effective Teaching study, Kane and Staiger (2012) reported that teachers scored lowest for complex teaching skills such as questioning, discussion techniques, and communicating with students about content. Teaching Works (2014) analyzed core teacher capabilities and developed a set of 19 high-leverage practices (HLPs) of which mastery will likely increase advances in student learning. The HLPs are based on research linking particular practices to student achievement (Loewenberg Ball & Forzani, 2010). The Teaching Works’ HLPs span across content, teacher style, and setting, and include eliciting and interpreting student thinking, and providing oral feedback on students’ work (Loewenberg Ball, Sleep, Boerst, & Bass, 2009), both of which take place in inquiry-based discussion. Danielson (2011) provided indicators for similar teaching capabilities, including higher-level questioning. Higher-level questions are defined as open-ended questions that allow students to use past experiences, prior knowledge, and previously learned content in order to create a well thought-out answer (i.e., question statements that begin with “How”, “What”, or “Why”) related to new content. For science teachers in particular, questioning appears to be the weakest element of instruction; researchers have proposed a core set of instructional practices for science teachers, including questioning to elicit student thinking (Windschitl et al., 2012).

Retooling Using Simulation

As researchers and policy makers converge on a core set of high-quality teaching practices and corresponding professional learning opportunities, what are the best professional learning environments for teachers? Computer simulation is taking center stage as a next generation environment for teacher learning, allowing teachers to learn both pedagogical and content skills. Dieker, Straub, Hughes, Hynes, and Hardin (2014) described simulated environments for improving teacher practice, such as TeachLivE – an immersive, mixed-reality classroom simulator that combines real and virtual worlds to give users a sense of immersion and presence. In TeachLivE, teachers interact with student-avatars in real time, holding authentic discussions on varied content areas. Over 50 universities and school district partners currently have TeachLivE classroom simulators for professional learning, and TeachLivE is currently the only mixed-reality classroom simulator of its kind. Simulation can provide many educational experiences and opportunities that may not be available in real-world settings (Dieker, Rodriguez, Lignugaris/Kraft, Hynes, & Hughes, 2014; Nagendran, Pillat, Kavanaugh, Welch, &
Hughes, 2014) and allow for safe rehearsal of skills until mastery. Simulated environments provide a safe place to practice teaching behaviors at an accelerated pace and receive rapid corrective feedback (Dieker et al., 2014a; McPherson, Tyler-Wood, McEnturff, & Peak, 2011). A research base is emerging, focusing on the use of TeachLivE with teachers and teacher candidates, and TeachLivE is currently in its fourth generation of student-avatars (see Andreasen & Haciomeroglu, 2009; Dawson & Lignugaris/Kraft, 2013; Elford, Carter, & Aronin, 2013; Elford, James, & Haynes-Smith, 2013; Straub, Dieker, Hynes, & Hughes, 2014; Vince Garland, Vasquez, & Pearl, 2012; Whitten, Enicks, Wallace, & Morgan, 2013).

Simulation provides unique capabilities; teachers can receive just-in-time professional learning; simulation that incorporates after-action-review based on the theoretical model of performance mastery through feedback (e.g., Hattie & Timperley, 2007) has the potential to reduce discrepancies between current performance and a goal. Immediately after the simulation, teachers take part in an after-action-review process to engage in structured reflection and receive feedback on performance (Baird, Holland, & Deacon, 1999; Smith & Allen, 1994). Hattie and Timperley (2007) suggested setting learning goals, data on actual performance, and revising learning goals based on performance. This immediate behavior shaping cannot happen in a real classroom, as real students would have to wait while their teacher received corrective feedback. Avatar students can be “paused” and wait patiently without losing valuable instructional time. Most importantly, teacher can re-enter the environment to fix instructional errors with student-avatars without affecting real students. Immersive virtual environments have the potential to revolutionize professional learning, but more research is needed to establish the efficacy of the use of simulation for teacher education. One of the purposes of this research study is to evaluate the use of a classroom simulator with high fidelity (TeachLivE) to affect actual classroom instruction. In this study, we gave teachers an opportunity to practice use of HLPs in TeachLivE and to evaluate the generalization of those practices to the traditional classroom setting.

Impact on Student Learning

Ultimately, our efforts toward a current and rigorous model of teacher PD should aim for positive impacts on student learning. If shifts in teacher PD do not increase student learning, then the purpose of PD should be re-envisioned to incorporate new findings and practices in the field. Science students whose teachers use HLPs should show increases in student learning; therefore supporting teachers’ HLPs using TeachLivE should result in corresponding improvements in student learning. The core goal of this project is to support teachers as their practices shift to accommodate the new student learning standards, so they can improve academically. The effects of Phase II professional development on student learning are provided in a companion report.

Theoretical Framework and Overarching Hypotheses

Our work in computer simulation is grounded in Brown, Collins, and Duguid’s (1989) theory of situated cognition asserting, “what is learned cannot be separated from how it is learned and used” (p. 88). We believe learning occurs in contextually meaningful settings (Dieker et al., 2014) and we created a contextualized simulation activity that provided learners with the opportunity to practice HLPs with student-avatars. Our theory of action arises from examining the critical features of professional learning for teachers that are related to increased student outcomes (e.g., active learning opportunities based on specific teaching practices, such as HLPs). Based on results from Phase I of a national research study investigating simulation in...
middle school mathematics classrooms, coupled with findings from earlier studies related to using virtual environments for teacher preparation (see Straub, Dieker, Hynes, & Hughes, 2014), our overarching hypothesis was that teachers who engage in virtual environment simulations in high school science, specifically biology, would improve their practice in the simulator and this practice will transfer back to their classroom. Specifically, we hypothesized that four 10-minute sessions of virtual rehearsal (i.e., practicing the same lesson and HLPs in TeachLivE) would significantly increase teachers’ frequency of open-ended questions and content-related affirmation to students in both simulated and real classroom instruction, compared to their colleagues who did not engage in TeachLivE.

Changes in Research and Context from Phase I to Phase II

This national research study spanned two years, and in Phase II, methods were revised to incorporate findings from Phase I and test new technology components. While the same overarching hypotheses and questions framed the research, innovations in technology enabled researchers to utilize new high school avatars and computer-based feedback. In Phase II a new set of avatars was developed significantly for high school teachers in TeachLivE. The Phase II high school avatars were the same characters with the names and personality types from Phase I, but the nuances of their behaviors and look were that of high school students (see Figure 1).

Evolution of System to Include High School Avatars

The creation of the high school version of our five virtual students was an opportunity to improve our processes, both in the artistic development and in the pipeline that brings the artistic assets into the AMITIES Framework (the system that operates TeachLivE). The artistic goal was to create models that could be easily adapted to accommodate different clothing, hairstyles, and other cosmetic changes. The pipeline enhancements included automating the process of exporting the artistic assets (models, textures, animations, etc.) so that naming and folder structure conventions are adhered to in a manner that guarantees ease of importing these assets into the framework that provides interaction paradigms, game mechanics, and visual rendering.

The character modeling process for the high school avatars is significantly different and more scalable than the one used to produce the middle school avatars. Although both are based on skeletal models needed to support animation, after that there is a major improvement from the latter to the former. In the case of the middle school students, the clothing, accessories, and hair are all part of their “skins” and are not removable, because originally it was determined that they did not need to be changed. This convenience greatly reduced modeling time but created a set of “one-off” models. In contrast, each high school avatar has clothing, accessories, and hair that are independent of his or her body (skin). This change makes it possible to personalize appearances to match the cultures of different clients or even to have dress-up or dress-down days.

Beyond the above issues of clothing as skin, each middle school student’s desk and chair are actually part of the student’s model. This means the student cannot be separated from the desk and so cannot walk to the whiteboard. It even means that removal of a student from the classroom results in removal of his or her desk and chair. The high school students, in contrast, are independent of environmental objects and so can be moved from chair to chair, walk to the whiteboard, fall to the floor, or even be replaced by other students. Figure 2 shows Kevin (student at far left) replaced by a new student, Bailey, and the empty desk between Sean and
Maria occupied by another new student, Martin, who has just gone to the whiteboard. These changes were more about commercialization and building a pipeline process for avatars, but also added a new level of movement and authenticity to the study in Phase II.

Figure 1. High School TeachLivE Avatars

Figure 2. Changing Out and Moving Characters
Evolution of Research Tools, Data Collection, and Learning Evaluation

The method for delivering feedback also changed substantially in Phase II based on lessons from the study. While the same type of information was shared with teachers after their PD sessions in TeachLivE, the format changed and results were no longer delivered on paper by a human facilitator, but by a computer on a screen immediately after the simulation. Anecdotal evidence from Phase I of the study yielded concerns from teachers that data presented during the after-action-review process was not valid, because researchers had scored teachers incorrectly. A search of literature indicated mixed findings related to computer versus human-delivered feedback. Differential performance resulted when participants received feedback from a computerized source (Earley, 1988) and participants were more likely to seek feedback from a computer than from another person (Kluger, 1993). However, supervisor-mediated feedback has been associated with higher levels of perceived fairness than computer-mediated feedback (Alder & Ambrose, 2005). In light of mixed feelings related to format for delivering feedback, Hattie and Timperley’s (2007) meta-analysis of effect sizes indicated stronger effects for computerized feedback than non-computerized feedback. This finding guided the decision to deliver performance feedback from a computer in Phase II of the research on TeachLivE.

Revisions were made to data collection methods and tools for teachers and students. Teachers in Phase I were not required to teach a uniform lesson at all sites during classroom observations, and this decision resulted in a wide variance among teachers’ lesson formats and content. However, in Phase II, teachers all taught the same lesson, and this change significantly limited construct irrelevant vehicles and attempted to unify observable behaviors that guided teachers’ philosophical approach to teaching. Lesson plans in Phase II were explicitly designed to enhance science literacy and aligned with Disciplinary Core Ideas and Cross-cutting Concepts from the Next Generation Science Standards, as well as the Common Core Standards for Literacy in Science. Lessons in Phase II incorporated Literacy Design Collaborative (LDC) mini-tasks – small, scorable assignments that address a particular literacy skill a teacher has targeted based on the needs of students (LDC, 2015). Concept map mini-tasks were embedded just before and after each lesson. The lesson plans, based on the 5E Instructional Model, were validated and field-tested in high school biology classrooms as part of a larger module from the NIH Curriculum Supplement Series (National Institutes of Health, 2005). All of these efforts were aimed at creating a uniform basis for observing teachers and comparing results of PD for an inquiry-based approach to teaching. Also, while teachers were still observed through the lens of HLPs, researchers accommodated new types of discussion questions that challenged students to think at the highest levels of Bloom’s taxonomy (Anderson et al., 2001; Bloom, 1956), creating new ideas and knowledge. As such, student data collection tools were revised to capture the number of content-related ideas students had before and after their teachers received TeachLivE.

Finally, more emphasis was placed on the collection and evaluation of student learning outcomes. Because the focus of this report is on teacher performance, the results as they relate to changes from Phase I to Phase II follow. In Phase I of the study, no significant difference was found between students’ learning based on intervention groups using a 10-item instrument based on the NAEP for eighth grade mathematics. To tease out possible impact on student learning, the researchers extended their data collection in Phase II, by adding an additional instrument. Data were collected on: (1) a 10-item multiple choice assessment based on the College Board (2013) SAT Subject Test in Biology, similar to the format in Phase I, and (2) a concept map...
administered pre- and post-lesson at each observation in order to collect data about students’ number of content-related ideas generated. The aim was to establish whether students not only increased content knowledge as demonstrated on a general measure, but also increased their number of ideas related to the content in response to teachers’ increased questioning as supported by TeachLivE. Specific procedures for collecting and analyzing the large volume of student data generated in this project are presented in detail in an upcoming complementary report.

Research Questions

Phase II of this research study focused on replicating findings from Phase I. In the TeachLivE classroom simulator, we had the following research questions:

Research Question 1: Are there differences in performance over four 10-minute sessions of TeachLivE on teacher practice (i.e., questions) during a 10-minute simulation when performance feedback is given?

The ability to receive feedback in a timely, objective manner is a perceived benefit of simulation, so it was important to investigate the impact of after-action-review of teacher performance. We hypothesized withholding feedback on a specific teacher practice (i.e., frequency of content-related affirmation) would result in no difference in performance.

Research Question 2: Are there differences in performance over four 10-minute sessions of TeachLivE on teacher practice (i.e., frequency of content-related affirmation) during a 10-minute simulation when no performance feedback is given?

Valuable change in teacher practice should occur not only in a virtual classroom, but also in a real classroom with students present. Our next research questions were designed to evaluate teacher performance in the classroom.

Research Question 3: What are the effects on teaching practice (i.e., questions) in a classroom after four 10-minute sessions of TeachLivE?

Research Question 4: What are the effects on teaching practice (i.e., frequency of content-related affirmation) in a classroom after four 10-minute sessions of TeachLivE?

In terms of social validity of the intervention, it is important to know whether or not teachers perceived the avatars as realistic and whether PD was of value (Wolf, 1978). Our next research question was designed to collect information on teachers’ perceptions related to TeachLivE.

Research Question 5: What are the perceptions of practicing teachers related to presence and perceptions of preparedness after completing TeachLivE?

Method

Participant Characteristics

Data analyzed in this study were collected during the second year of a three-year project at 11 separate research locations, including university and school district partners. Participants were the primary teachers of record, and primarily high school biology teachers. There were no restrictions on the education level of a teacher, number of years teaching, level of class taught,
subject area within science, or any other demographic characteristics. Overall, 104 teachers completed the study. Demographic data for all participating teachers are presented in Table 1.

Table 1. Teacher Demographic Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Comparison (n = 51)</th>
<th>TeachLive (n = 53)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Professional licensure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>6 (12)</td>
<td>48 (91)</td>
</tr>
<tr>
<td>No</td>
<td>40 (78)</td>
<td>2 (4)</td>
</tr>
<tr>
<td>No response</td>
<td>5 (10)</td>
<td>3 (6)</td>
</tr>
<tr>
<td>If licensed, is license in science?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>35 (69)</td>
<td>37 (70)</td>
</tr>
<tr>
<td>No</td>
<td>1 (2)</td>
<td>4 (8)</td>
</tr>
<tr>
<td>No response</td>
<td>15 (29)</td>
<td>12 (23)</td>
</tr>
<tr>
<td>Area of certification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grades 6-12</td>
<td>26 (51)</td>
<td>26 (49)</td>
</tr>
<tr>
<td>Other</td>
<td>6 (12)</td>
<td>8 (15)</td>
</tr>
<tr>
<td>No response</td>
<td>19 (37)</td>
<td>19 (36)</td>
</tr>
<tr>
<td>Highest academic level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor's</td>
<td>18 (35)</td>
<td>27 (51)</td>
</tr>
<tr>
<td>Master's</td>
<td>27 (53)</td>
<td>21 (40)</td>
</tr>
<tr>
<td>Doctorate</td>
<td>2 (4)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>No response</td>
<td>4 (8)</td>
<td>4 (8)</td>
</tr>
<tr>
<td>Area of masters degree</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>7 (14)</td>
<td>6 (11)</td>
</tr>
<tr>
<td>Other</td>
<td>19 (37)</td>
<td>18 (34)</td>
</tr>
<tr>
<td>Not applicable or No response</td>
<td>25 (49)</td>
<td>29 (55)</td>
</tr>
<tr>
<td>Years teaching science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One year</td>
<td>3 (6)</td>
<td>7 (13)</td>
</tr>
<tr>
<td>Two years</td>
<td>10 (20)</td>
<td>5 (9)</td>
</tr>
<tr>
<td>Three years</td>
<td>1 (2)</td>
<td>3 (6)</td>
</tr>
<tr>
<td>Four years</td>
<td>3 (6)</td>
<td>4 (8)</td>
</tr>
<tr>
<td>5-10 years</td>
<td>13 (25)</td>
<td>12 (23)</td>
</tr>
<tr>
<td>More than 10 years</td>
<td>17 (33)</td>
<td>17 (32)</td>
</tr>
<tr>
<td>No response</td>
<td>4 (8)</td>
<td>5 (9)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-29</td>
<td>14 (27)</td>
<td>19 (36)</td>
</tr>
<tr>
<td>30-39</td>
<td>12 (24)</td>
<td>14 (26)</td>
</tr>
<tr>
<td>40-49</td>
<td>13 (25)</td>
<td>8 (15)</td>
</tr>
<tr>
<td>50 or above</td>
<td>8 (16)</td>
<td>9 (17)</td>
</tr>
<tr>
<td>No response</td>
<td>4 (8)</td>
<td>3 (6)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>10 (20)</td>
<td>9 (17)</td>
</tr>
<tr>
<td>Female</td>
<td>37 (73)</td>
<td>41 (77)</td>
</tr>
<tr>
<td>No response</td>
<td>4 (8)</td>
<td>3 (6)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>5 (10)</td>
<td>3 (6)</td>
</tr>
<tr>
<td>Black</td>
<td>6 (12)</td>
<td>4 (8)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>4 (8)</td>
<td>3 (6)</td>
</tr>
<tr>
<td>White</td>
<td>27 (53)</td>
<td>39 (74)</td>
</tr>
<tr>
<td>Other</td>
<td>5 (10)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>No response</td>
<td>4 (8)</td>
<td>3 (6)</td>
</tr>
</tbody>
</table>

Teachers indicated having taught the following grade levels:

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Control Group</th>
<th>TeachLive Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>K - grade 5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Grades 6 - 8</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Grades 9 - 12</td>
<td>46</td>
<td>43</td>
</tr>
</tbody>
</table>
Sampling Procedures

Participants were identified via a convenience-sampling plan. Approximately 150 high school biology teachers were initially recruited across 11 separate research locations. All teachers agreed to teach a science content-based lesson plan. At each partnership site, teachers were self-nominated or nominated by their supervisors with the intent of receiving lesson resources. Of those teachers, 129 completed a half-hour orientation and began participation in the research project, resulting in about 86% participation of the sample approached. Participation was entirely voluntary with minimal to no compensation provided.

Data were collected in two settings: teachers’ classrooms and the classroom simulator. Teachers were observed in secondary classrooms at 11 sites across the following states: Florida, Georgia, Idaho, Illinois, Louisiana, Maryland, New York, Texas, and Washington, D.C. School settings ranged over urban, suburban, and rural, with public or private enrollment. Classroom simulators were located near teachers’ classrooms at university or school district partner sites.

Teachers voluntarily participated and in most cases were motivated to do so because of access to professional learning resources. The research team leading the study did not offer direct compensation; however, each site was free to offer incentives for participation based on local conventions. All incentives were valued at less than $200 per teacher and came in the form of a stipend or points awarded for PD supplied by the district. For recruiting purposes, the project was described as Next Generation PD with the benefit of working in a computer-simulated environment with innovative technology. Institutional review boards at each site and within each school district examined and approved all procedures, granting permission to conduct research.

Sample Size, Power, and Attrition

The intended sample size was 200 participants, favoring high school biology teachers only; however, respondent participation numbers were low, so teaching content area was expanded to include all teachers at secondary level. Consequently, most teachers taught science content areas, with a minority of teachers in subjects such as English and special education. As with Phase I, multiple districts were approached but chose not to participate due to concerns that the professional learning would duplicate their own activities or conflict with their district initiatives. Phase II research methods required that all teachers deliver the same lesson plan for Observation 1 and another lesson for Observation 2, which resulted in many logistical challenges for districts and participants following predetermined curriculum pacing guides and for many sites this study occurred during a very difficult winter that greatly impacted the ability to retain all participants. While the content and format of the lesson afforded flexibility, many teachers were reticent to carve out valuable instructional time and did not participate in the study or were no longer available due to weather-related cancellation of school days in the north and northeast.

Power analysis for sample size. In a review of the literature, the only similar study identified using a large group design for practicing teachers’ PD in a classroom simulator was research conducted in Phase I. Effect sizes were reviewed to offer an estimate of the desirable effect size, yielding a range from small to large of $\eta^2_p = 0.025 \text{ to } 0.149$. An a priori power analysis was conducted (Cohen, 1988) using a medium sized effect (0.25). Power analysis for an F-test Analysis of Variance (ANOVA) within-between interactions resulted in a total sample size of 48 participants to have 80% power for detecting a medium sized effect (0.25) when employing a
0.10 criterion of statistical significance. As with Phase I, a 0.10 criterion was selected due to the new research in the field with a low risk to humans; therefore, a larger Type Two error was acceptable in considering the overall findings. The projected number of participants was 200, based on funding allocated for the research project. The anticipated number of participants exceeded the suggested number of 48 participants for a medium sized power effect.

Research Design

The research design was a randomized controlled trial, consisting of two groups of teachers measured pre-post in the classroom, half of whom were also measured four times in the classroom simulator. The random assignment procedure took place at all 11 partnership sites, resulting in two experimental groups.

Interventions

Teachers were assigned to one of two groups, and both groups received the same lesson plan resources. The lesson plans were designed to enhance science literacy and aligned with Disciplinary Core Ideas and Cross-cutting Concepts from the Next Generation Science Standards and the Common Core Standards for Literacy in Science. The lesson plans were based on the 5E Instructional Model and were validated and field-tested in high school biology classrooms as part of a larger module from the NIH Curriculum Supplement Series “Using Technology to Study Cellular and Molecular Biology” (National Institutes of Health, 2005). Lesson 1, entitled “What is Technology?” was the basis for the first observation, while Lesson 2, entitled “Modeling Issues” was the basis for the second observation (see Appendices A and B). In Phase I, teachers had taught a variety of content and lesson formats, resulting in construct irrelevant variance. As a means of removing potentially confounding variables, all teachers taught Lesson 1 at a pre-treatment observation and Lesson 2 at post-treatment observation. In this way, lesson, content, and format were standardized at the 11 sites across the country. Lesson 1 also had an accompanying video model of a teacher teaching Lesson 1 using HLPs in a real classroom.

Both lessons had the same structure and parallel content. The lesson began with a concept map, which served as a mini-task literacy activity (LDC, 2015). Teachers showed a model concept map and explained the components to students (see Appendix C), then gave the students five minutes to generate as many ideas as possible related to the prompt in the center of the map. The prompts corresponded directly to the lesson with the purpose of eliciting content-related student thinking just before and after the lesson. During the lesson, teachers facilitated a whole class discussion focused on interpreting, inferring and deducing from data, and integrating information to form conclusions. At the close of the discussion, students completed an identical concept map responding to the same prompt. In this way, each student created two concept maps on the same topic and learning was assessed by changes between maps.

Students responded to the 10-item curriculum-based assessment prior to Lesson 1 and after Lesson 2. All teachers received the lesson plans and accompanying video resources via email after orientation and prior to the first observation. Two observations were scheduled at least three weeks apart (one for each lesson) and treatment took place in between observations. Group 1 teachers served as a comparison group and received lesson plan resources while Group 2 teachers received the same lesson plan resources plus four 10-minute sessions of TeachLivE. See Figure 3 for an overview of both treatment groups.
**Group 1: Comparison.** Comparison teachers received Lessons 1 and 2 and the accompanying video for Lesson 1 via email. They were given no other intervention as a course of this study, but received any PD provided by their districts during the course of the school year. They taught Lesson 1 at pre-treatment observation and Lesson 2 at post-treatment observation.

**Group 2: Simulation.** Simulation teachers received lessons and resources (like the comparisons teachers), as well as four 10-minute virtual rehearsal sessions in the TeachLivE classroom simulator. In the simulator, teachers attended individually and interfaced with a computer-generated, animated student population of five high school avatars digitally controlled by a professional who enacted a highly interactive, authentic simulation of a high school classroom. The software is programmed to react to certain commands of the teacher and the interactor, with the purpose of increasing the teacher’s aptitude in the classroom. Classroom simulators at 10 client sites across the country were connected via a secure server to the Synthetic Reality Laboratory at the University of Central Florida, which served as the central distribution point for TeachLivE and provided fidelity of treatment that all sessions were controlled at the primary research site. For operation at the teacher client sites, the simulator required a computer with TeachLivE software, large display monitor, webcam, lavaliere microphone, speakers, system for tracking movement, and an Internet connection. A session facilitator, trained on how to use the software and enact the research procedures, facilitated the sessions and collected the data. A computer with TeachLivE software, monitor, and motion tracking devices were needed to operate the system at the interactor’s server. The teachers experienced computer-simulated classroom activities with the student-avatars as they would with human students in a traditional classroom. Visits to the simulator took place over the course of three to four weeks following the first classroom observation.

Simulation teachers participated in one 10-minute session to orient them to the simulation system. Data were not collected during the orientation session, as users were not teaching content but interacting with the student-avatars to learn about their class. After orientation, teachers received four 10-minute sessions (sessions 1 through 4) of virtual rehearsal (i.e., targeted practice of a skill in a virtual environment), with data on targeted behaviors gathered during each session. After orientation, teachers typically took part in two 10-minute sessions and returned within a month for another two 10-minute sessions. Teachers were instructed to follow the first 10
minutes of Lesson 1 (beginning immediately after students had completed the concept maps) for each session.

**After-Action-Review.** At the close of each session, teachers took part in an after-action-review of their performance, led by a facilitator using a digital chart displayed on a large video monitor (approximately 60”). This process of computerized feedback was a complete departure from Phase I methods, in which facilitators had written performance data on a piece of paper and handed it to participants. Methods were refined based on participant feedback from Phase I, so that results were now displayed digitally. After-action-review consisted of four parts: (1) teachers were presented with frequency of observed behaviors (i.e., closed-ended questions (CE), open-ended questions (OE), and open-ended plus questions (OE+); detailed definitions of each behavior are provided below) during the session verbally and on a large display; (2) teachers read examples of question types CE, OE, and OE+ on a large display; (3) teachers were asked to set a goal for their performance in the next session on OE questions; (4) just prior to commencing the session, teachers stated their target goal number of OE questions. Upon completion of the after-action-review, teachers returned to the simulation for another session. Performance on content-related affirmation (CRA) was withheld from participants in order to evaluate simulation with no after-action-review. Table 2 describes the after-action-review process.

Table 2. After-Action-Review Process

<table>
<thead>
<tr>
<th>Step</th>
<th>CE</th>
<th>OE</th>
<th>OE+</th>
<th>CRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: Data display</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2: Read examples</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2: Teachers set</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 4: Teachers</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Measures and Covariates**

Data were collected on a variety of measures from teachers and their students, including qualitative and quantitative measures. To ensure that all 11 sites had high reliability in data collection, researchers employed methods to enhance the quality of measurements. As with Phase I, due to the national nature of the study, training observers across the country presented challenges in terms of training and reliability of observations. Therefore, all data collectors were trained online using a combination of asynchronous assessment and synchronous data collection training on the constructs (e.g., Danielson sub-constructs and HLPs) and methods (e.g., frequency counts during rotating intervals as described above) for data collection. Data collectors used the asynchronous online modules to demonstrate proficiency with the content of observations. Each practice was defined and a case example was provided. Observers had to pass a multiple-choice content assessment with 90% accuracy for the asynchronous portion of the training. The synchronous online training was enhanced from Phase I, and consisted of a series of rigorous activities delivered via a video conferencing platform that exposed observers to watching a video online as a group to simulate classroom observations. Each observer was
checked for reliability during the online training and required to complete a synchronous online activity with 90% accuracy.

**Data Collection.** As with Phase I, in Phase II quantitative and qualitative observations on the Teacher Practice Observation Tool (TPOT; see Appendix D) were used to collect data on teachers in their classrooms pre- and post-treatment. See Table 3 for an overview of data sources.

### Table 3. Overview of Data Sources

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Individuals</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher demographics</td>
<td>Teachers</td>
<td>Professional Development Questionnaire</td>
</tr>
<tr>
<td>Teaching practice in TeachLivE classroom simulator</td>
<td>Teachers</td>
<td>ReflectLivE After-Action-Review System</td>
</tr>
<tr>
<td>Teacher perceptions of TeachLivE experience</td>
<td>Teachers</td>
<td>TeachLivE Presence Questionnaire</td>
</tr>
<tr>
<td>Teacher perceptions of preparation after TeachLivE</td>
<td>Teachers</td>
<td>TeachLivE Perceptions Questionnaire</td>
</tr>
<tr>
<td>Teaching practice in classroom</td>
<td>Teachers</td>
<td>Teacher Practice Observation Tool</td>
</tr>
<tr>
<td>Student academic performance</td>
<td>Students</td>
<td>Curriculum-based measure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cognitive Maps Scores</td>
</tr>
<tr>
<td>Student demographics</td>
<td>Students</td>
<td>Cross-reference Demographic Sheet</td>
</tr>
</tbody>
</table>

Teachers responded to demographic questions prior to treatment. During classroom simulator observations, data were collected on the frequency of HLPs determined to increase the likelihood that these teaching behaviors would have a positive effect on students’ learning outcomes (Teaching Works, 2014). For the teachers who experienced the classroom simulator, data were also collected on their sense of presence and preparedness after the first four sessions of virtual rehearsal. Observers focused simultaneously on two variables – questioning and feedback – throughout the 10-minute session. In the real classroom, observers collected data on frequency of HLPs as well as on modified sub-constructs from the 2011 Danielson Framework for Teaching Evaluation Instrument (Danielson, 2011). Qualitative field notes on teacher practice were taken during observations. Data were collected in nine-minute intervals (five intervals for a total of 45 minutes), rotating across constructs such that observers focused on one construct at a time, except in the case of Affirmation and Student Talk variables (see Appendix D). Table 4 described the variables observed in the real classroom and the classroom simulator.
Table 4. Variables Observed in the Classroom and Classroom Simulator

<table>
<thead>
<tr>
<th>Variables</th>
<th>Classroom</th>
<th>Classroom Simulator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One period</td>
<td>10-minute session</td>
</tr>
<tr>
<td></td>
<td>45 minutes</td>
<td>(4 observations)</td>
</tr>
<tr>
<td></td>
<td>(2 observations)</td>
<td></td>
</tr>
<tr>
<td>High-leverage Practices</td>
<td>Questioning (Two Types)</td>
<td>Questioning (Two Types)</td>
</tr>
<tr>
<td></td>
<td>Content-related Affirmation</td>
<td>Content-related Affirmation</td>
</tr>
<tr>
<td>Type of Data Collected</td>
<td>Questioning (3-minute intervals)</td>
<td>Frequency or Percentage per</td>
</tr>
<tr>
<td></td>
<td>Content-related Affirmation</td>
<td>10-minute session</td>
</tr>
<tr>
<td>Sub-constructs from 2011</td>
<td>8 sub-constructs modified</td>
<td></td>
</tr>
<tr>
<td>Danielson Framework for Teaching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of Data Collected</td>
<td>-Sum of observer ratings at the end of the observation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Structured protocol of field notes for 2 minutes every 9 minutes</td>
<td></td>
</tr>
</tbody>
</table>

**High-leverage practices.** Using research from the Measures of Effective Teaching project, descriptions of HLPs, and other empirically-based research in the field, operational definitions for observation were created (See Appendix E for Operational Definitions Quick Reference Sheet used by observers).

Data were collected on teachers’ frequency and type of eliciting and interpreting individual students’ thinking (HLP #3). The same measures occurred in the classroom simulator and pre-post in the real classroom. Each simulator session lasted 10 minutes so the frequency and type of instances for each behavior were noted. In the teachers’ classrooms, the prescribed lesson was 45 minutes in length.

- closed-ended questions (CE): content questions that have restricted parameters, expecting one possible response as its only acceptable answer; constrains a student’s response, such as test questions, yes-no questions and forced choice questions.
- open-ended questions (OE): content questions to which a number of different answers would be acceptable; content questions that have no parameters and do not constrain student’s response. Open-ended plus questions (see definition below) were included in this category for data collection purposes.
• open-ended plus questions (OE+): content questions that ask a student to extend, produce, or combine ideas to generate new ideas (related to Bloom’s highest cognitive domain – creating). Open-ended plus questions were included in the open-ended questions category.

Observers also looked for content-related affirmation (e.g., feedback) from teachers. Effective feedback is specific, not overwhelming in scope, focused on the academic task, and supports students’ perceptions of their own capability (HLP #12 and 16). As with questions, in the classroom simulator, frequency data of CRA were collected in each 10-minute session. In the teachers’ real classrooms, the prescribed lesson was 45 minutes in length. For the purposes of this study, the focus was only on affirmation related to content, which was defined as:

• content-related affirmation (CRA): teacher’s positive verbal affirmation about what a student or group of students did or said related to content in a single episode within class (multiple statements about the same episode count as one occurrence of affirmation).

Sub-constructs from 2011 Danielson Framework for Teaching. As with Phase I, eight sub-constructs that correlated with student achievement from the 2011 Danielson Framework for Teaching Evaluation Instrument (Measures of Effective Teaching Project, 2010) were identified. Key words from Danielson’s indicators were chosen to create an abbreviated version for classroom observations, and combined with the collection of frequency data in relation to describe/explain questions, specific feedback, and wait time. Danielson’s four levels of performance (i.e., unsatisfactory, basic, proficient, distinguished) were the basis for a four-point scale for each sub-construct: establishing a culture for learning, engaging students in learning, managing student behavior, managing classroom procedures, communicating with students, using questioning and discussion techniques, creating an environment of respect and rapport, and using assessment in instruction. Further, qualitative data were collected during the classroom observation on each sub-construct listed above using a field notes method. See Appendix D for the TPOT that includes each sub-construct and associated scale. For a description of TPOT development, see Straub, et al. (2014). Reliability estimates related to each variable are provided in the results section.

ReflectLivE: After-Action-Review System. During each TeachLivE session, the teacher’s virtual rehearsal was transmitted via secure Skype video and audio connection. The transmissions were recorded and coded for pedagogical strategy analysis using ReflectLivE software. ReflectLivE is a video tagging software integrated with the TeachLivE classroom simulator; it records sessions, compresses the video to a smaller format, storing all data (video and tags) on the observer’s workstation. These data can then be sent over a secure network to be stored at the originating research site computer containing the TeachLivE software. During each session, videos were tagged for frequency of questions and content-related affirmation. As with Phase I, a beta version of ReflectLivE was used in Phase II of the project, and brought about intermittent issues with recording and exporting of tags, so data were also collected using a paper and pencil backup to maintain integrity. A new tool was developed for Phase II to automatically gather data related to student talk time in the simulator. As the avatars’ mouths moved, the system logged the time spent “talking” and automatically calculated a percentage of student talk to total time in the session. Because this tool was in the beta version, the measurements were not yet validated; moreover, observers were not always consistent in when they started the recordings. As a result of these inconsistencies, these data were not analyzed.
TeachLivE questionnaires. Each teacher that entered the classroom simulator was administered two researcher-created questionnaires in order to collect data on the social validity of the intervention:

- TeachLivE Presence Questionnaire (Hayes, Hardin, & Hughes, 2013): Teachers responded to questions about their simulation experience related to suspension of disbelief, presence, fidelity, and immersion.

- TeachLivE Perceptions Questionnaire (Hayes, Hardin, & Hughes, 2013): Teachers also responded to items about how virtual rehearsal in the classroom simulator prepared them for teaching in their own classrooms.

Results

At the beginning of the research study, 129 teachers completed orientation and were randomly assigned to four groups in a randomized, controlled trial design (see Table 5); however, teacher requests to change treatment groups necessitated a modification resulting in the final quasi-experiment design (Step 1 of participant flow through the quasi-experiment). Once scheduling began, seven teachers requested to be removed from the study or to be changed to a different treatment group due to scheduling restrictions (Step 2 of participant flow). Four teachers wanted to continue participation, but could not complete the activities due to prior commitments, so they were moved from the simulation to the comparison group. Three teachers requested to be moved from comparison to simulation to increase their level of treatment and potentially receive benefits of simulation. While changes in treatment group did violate random assignment procedures, all changes occurred prior to interventions so that no teachers received a partial intervention and then switched to another group midway through an intervention. Teachers attended events individually; therefore, group assignment could occur prior to the intervention. Table 5 outlines the participant flow through each stage of the study. First, teachers were randomly assigned to treatment groups; then teachers made requests to change groups and some teachers were lost to attrition (Step 3 of participant flow), resulting in the final number of teachers per treatment group prior to beginning treatment.

Table 5. Participant Flow through the Quasi-Experiment

| Step 1: Teachers oriented and randomly assigned | 56 | 73 | 129 |
| Step 2: Changes in groups per teacher request | From Comparison to Simulation | 3 | N/A |
| From Simulation to Comparison | N/A | 4 |
| Step 3: Teachers lost to attrition | -6 | -19 | -25 |
| Step 4: Final number of teachers per group | 51 | 53 | 104 |
Treatment Fidelity

Fidelity checks were in place throughout the study. All teachers received the lesson plan digitally, as evidenced by a checklist of teacher contact information at each site. The interactor controlling the five high school avatars was trained to follow five distinct patterns of behavior aligned to common student perceptions related to Lesson 1 content, and to maintain consistent, authentic responses that would reset with each interaction. However, fidelity of implementation data were not collected on the avatars’ performance to measure consistency across participants during treatment. During the TeachLivE sessions, the facilitator followed a detailed procedural checklist to turn on and operate the software, ensuring fidelity of implementation.

Teacher Results

Teaching practices were defined on five distinct dimensions pre- and post-intervention: (a) closed-ended questions (CE); (b) open-ended questions (OE); (c) open-ended plus questions (OE+); (d) content-related affirmation (CRA); (e) summary score on the TPOT (TPOT Sum). Maxwell’s (2001) recommendation of moderate correlation (0.3 – 0.7) was the threshold for all variables to determine whether to conduct a multivariate analysis of variance. Content-related affirmation was excluded from the analysis because researchers did not predict significant findings. In the case of the variables under investigation, the majority did not meet correlation thresholds, so analysis of variance (ANOVA) tests were more appropriate. See Table 6 for correlations of dependent variables.

<table>
<thead>
<tr>
<th></th>
<th>CE Pre</th>
<th>CE Post</th>
<th>OE Pre</th>
<th>OE Post</th>
<th>OE+ Pre</th>
<th>OE+ Post</th>
<th>TPOT Sum Pre</th>
<th>TPOT Sum Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE Pre</td>
<td>1</td>
<td>.244</td>
<td>.117</td>
<td>.183</td>
<td>-.214</td>
<td>.051</td>
<td>.111</td>
<td>.281</td>
</tr>
<tr>
<td>CE Post</td>
<td>.244</td>
<td>1</td>
<td>.213</td>
<td>.380</td>
<td>.125</td>
<td>.183</td>
<td>.153</td>
<td>.183</td>
</tr>
<tr>
<td>OE Pre</td>
<td>.117</td>
<td>.213</td>
<td>1</td>
<td>.238</td>
<td>.275</td>
<td>.157</td>
<td>.351</td>
<td>.207</td>
</tr>
<tr>
<td>OE Post</td>
<td>.183</td>
<td>.380</td>
<td>.238</td>
<td>1</td>
<td>-.061</td>
<td>.094</td>
<td>.207</td>
<td>.263</td>
</tr>
<tr>
<td>OE+ Pre</td>
<td>-.214</td>
<td>.125</td>
<td>.275</td>
<td>-.061</td>
<td>1</td>
<td>.141</td>
<td>.127</td>
<td>.031</td>
</tr>
<tr>
<td>OE+ Post</td>
<td>.051</td>
<td>.183</td>
<td>.157</td>
<td>.094</td>
<td>.141</td>
<td>1</td>
<td>.198</td>
<td>.200</td>
</tr>
<tr>
<td>TPOT Pre</td>
<td>.111</td>
<td>.153</td>
<td>.351</td>
<td>.207</td>
<td>.127</td>
<td>.198</td>
<td>1</td>
<td>.649**</td>
</tr>
<tr>
<td>TPOT Post</td>
<td>.281</td>
<td>.183</td>
<td>.207</td>
<td>.263</td>
<td>.031</td>
<td>.200</td>
<td>.649**</td>
<td>1</td>
</tr>
</tbody>
</table>

Specific statistical tests used and variables under consideration are described in detail in the results section. Results are divided by simulator data and classroom data, and further subdivided by research question.

Classroom Simulator Results

Research Question 1: Differences in performance over time with simulation and performance feedback. To examine performance of teachers over four 10-minute sessions, a
within-subjects ANOVA was performed. Time (four sessions) was cast as a within-subjects factor with dependent variables of CE for question 1.1, OE for question 1.2, and OE+ for question 1.3. One observer collected data during all of the TeachLivE sessions. Due to the novel nature of the intervention (e.g., dearth of group design research identified on simulation in teacher education), an alpha level of .10 was established to judge statistical significance. Partial eta squared was used to interpret effect size rather than eta squared because a multifactor design was used (Pierce, Block, & Aguinis, 2004) in order to compare effects across different factorial designs used in the study (Levine & Hullet, 2002).

**Question 1.1: CE questions in simulator.** After each session, teachers were presented with data on CE questions verbally and on a large display, but no performance goals were set for subsequent sessions. Analysis was conducted with a within-subjects design ANOVA. Mauchly’s test of sphericity indicated that the assumption of sphericity had not been violated, $X^2(5) = 6.772$, $p = .238$. Results indicated a significant time effect ($F(3,87) = 3.710$, $p = .015$, $\eta^2_p = .113$). Pallant (2007) recommends interpreting partial eta squared using Cohen’s (1988) guidelines for eta squared effect size: small (.01), medium (.06), or large (.14). Mean scores decreased significantly at each session, which was expected because: (a) although feedback on performance was given, no performance goals were set for CE questions, and (b) teachers were focusing on increasing an opposing behavior of OE questions. See Table 7 for mean CE questions across 10-minute TeachLivE sessions.

Table 7. Mean CE Questions across 10-minute TeachLivE Sessions

<table>
<thead>
<tr>
<th>TeachLivE Sessions</th>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
<th>Session 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n$</td>
<td>30</td>
<td>9.6 (6.2)</td>
<td>8.7 (3.9)</td>
<td>6.7 (5.4)</td>
</tr>
<tr>
<td>$M$ (SD)</td>
<td>10.23 (6.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4. Frequency of CE Questions of Time
Question 1.2: OE questions in simulator. Teachers were primarily attempting to increase their frequency of OE questions. Analysis was conducted with a within-subjects design ANOVA. Mauchly’s test of sphericity indicated that the assumption of sphericity was violated, $X^2(5) = 93.798, p = .000$. Epsilon ($\varepsilon$) was 0.387, as calculated according to Greenhouse and Geisser (1959), and was used to correct the ANOVA. Results indicated no significant time effect ($F(1.162, 33.694) = .320, p = .609, \eta^2_p = .011$). Mean scores are displayed in Table 8 and frequency over time is displayed in Figure 5.

Table 8. Mean OE Questions across 10-minute TeachLivE Sessions

<table>
<thead>
<tr>
<th>TeachLivE Sessions</th>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
<th>Session 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M$ (SD)</td>
<td>16.65 (17.7)</td>
<td>15.37 (6.4)</td>
<td>17.5 (7.4)</td>
<td>17.5 (7.7)</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5. Frequency of OE and OE+ Questions over Time

Question 1.3: OE+ questions in simulator. As a specific subset of OE questions, OE+ questions were also measured. After each session, teachers were presented with OE+ data verbally and on a large display, and a definition for OE+ questions was read aloud; however, performance goals were not set for subsequent sessions because OE+ questions are part of a larger category of OE questions. Analysis was conducted with a within-subjects design ANOVA. Mauchly’s test of sphericity indicated that the assumption of sphericity was violated, $X^2(5) = 86.024, p = .000$. Epsilon ($\varepsilon$) was 0.795, as calculated according to Greenhouse and Geisser (1959), and was used to correct the ANOVA. Results indicated a significant time effect ($F(2.385, 69.178) = 4.789, p = .008, \eta^2_p = .142$). Mean scores are displayed in Table 9 and mean frequency of OE+ questions over time is displayed in Figure 6.
Table 9. Mean OE+ Questions across 10-minute TeachLivE Sessions

<table>
<thead>
<tr>
<th>n</th>
<th>Session 1 M (SD)</th>
<th>Session 2 M (SD)</th>
<th>Session 3 M (SD)</th>
<th>Session 4 M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>30 .73 (1.7)</td>
<td>.77 (1.0)</td>
<td>1.27 (2.1)</td>
<td>2.1 (2.1)</td>
</tr>
</tbody>
</table>

Research Question 2: Differences in performance over time with simulation and no feedback on performance. All of the above research questions were designed to investigate how providing performance feedback in an after-action-review of simulation would impact teacher practice in a classroom simulator. Researchers for question 2 evaluated the effects of withholding feedback on a specific teacher practice (i.e., frequency of content-related affirmation) in a classroom simulator. To examine performance of teachers over four 10-minute sessions, a within-subjects ANOVA was performed. Time (four sessions) was cast as a within-subjects factor with a dependent variable of CRA. After each session, teachers were not presented with any data related to CRA. One observer collected data on frequency of OE questions asked by teachers per TeachLivE session. Analysis was conducted with a within-subjects design ANOVA. Mauchly’s test of sphericity indicated that the assumption of sphericity was violated, $X^2(5) = 16.138, p = .006$. Epsilon ($\varepsilon$) was 0.718, as calculated according to Greenhouse and Geisser (1959), and was used to correct the ANOVA. Results indicated no significant time effect ($F(2.153, 62.43) = .455, p = .651, \eta^2 p = .015$), which was expected, because no feedback had been provided. Mean scores are displayed in Table 10, and mean frequency of CRA over time is displayed in Figure 7.
Table 10. Mean CRA across 10-minute TeachLivE Sessions

<table>
<thead>
<tr>
<th>TeachLivE Sessions</th>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
<th>Session 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>M (SD)</td>
<td>5.13 (4.0)</td>
<td>5.33 (3.2)</td>
<td>5.73 (5.7)</td>
<td>4.57 (3.6)</td>
</tr>
</tbody>
</table>

Figure 7. Frequency of CRA over Time

Classroom Results

To examine impact of simulation of teachers in a real classroom with students present, the next research questions were designed to evaluate teacher performance on variable that had been part of the after-action-review in the simulator. Research question 3.1 evaluates teacher performance on a general measure of teacher practice (TPOT), while more specific practices were evaluated in questions 3.2 (CE), 3.3 (OE), and 3.4 (OE+).

Research question 3: Classroom results of simulation with feedback performance.

Question 3.1: TPOT Sum. An observer collected data on the TPOT Sum and two others observed 30% of classes to establish inter-rater reliability. While performance feedback was not given using the TPOT Sum score as the measurement instrument, the score is considered to be a general measure of teacher performance. Reliability of scores between observers during both observations was calculated (pre-intervention, $r = .932$; post-intervention, $r = .882$). Results from a mixed ANOVA indicated there were not statistically significant changes in TPOT Sum scores between Observations 1 and 2 based on treatment group ($F(1,94) = .097, p = .757, \eta^2p = .001$). For main effects, there was neither a statistically significant difference between the first and second observation collapsed across treatment groups ($F(1,94) = 1.460, p = .230, \eta^2p = .015$),
nor between groups collapsed across observations \((F(1,94) = .555, p = .458, \eta^2_p = .006)\). Mean TPOT scores are displayed in Table 11; TPOT scores over time are displayed in Figure 8.

Table 11. Mean TPOT Scores over Time

<table>
<thead>
<tr>
<th></th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>n</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Comparison</td>
<td>46</td>
</tr>
<tr>
<td>TeachLivE</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>96</td>
</tr>
</tbody>
</table>

![TPOT Scores over Time](image)

Figure 8. TPOT Scores over Time

**Question 3.2: CE questions.** An observer collected data on CE questions asked by the teacher, and two others observed 30% of classes to establish inter-rater reliability. Reliability of scores between observers during both observations was calculated (pre-intervention, \(r = .929\); post-intervention, \(r = .798\)). Results from a mixed ANOVA indicated there were no statistically significant changes in frequency of CE questions between Observation 1 and 2 based on treatment group \((F(1,100) = .796, p = .374, \eta^2_p = .008)\). See Table 12 for mean frequency of CE questions over time by group and Figure 9 for mean frequency of CE questions over time.

Table 12. Mean CE Questions over Time by Group

<table>
<thead>
<tr>
<th></th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>n</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Comparison</td>
<td>50</td>
</tr>
<tr>
<td>TeachLivE</td>
<td>52</td>
</tr>
<tr>
<td>Total</td>
<td>102</td>
</tr>
</tbody>
</table>
**Question 3.3: OE questions.** An observer collected data on the number of OE questions asked by the teacher, and two others observed 30% of classes to establish inter-rater reliability. Reliability of scores between observers during both observations was calculated (pre-intervention, $r = .864$; post-intervention, $r = .954$). Results from a mixed ANOVA indicated there were no statistically significant changes in frequency of questions between Observation 1 and 2 based on treatment group ($F(1,100) = 1.299$, $p = .257$, $\eta^2 = .013$). To determine the difference between groups at each level of time and vice versa, separate ANOVAs were run. There was no significant difference between treatment groups at Observation 1 ($F(1,102) = 1.079$, $p = .301$, $\eta^2 = .010$) or Observation 2 ($F(1,100) = .194$, $p = .661$, $\eta^2 = .002$). When comparing main effects over time by group, for the Comparison group, OE questions were not statistically significantly different between observations ($F(1,49) = .282$, $p = .598$, $\eta^2 = .006$). However, for the TeachLivE group, OE questions were statistically significantly different between observations ($F(1,51) = 4.403$, $p = .041$, $\eta^2 = .079$), with teachers increasing OE questions from Observation 1 ($M = 9.81$, $SD = 5.83$) to Observation 2 ($M = 12.35$, $SD = 7.62$). See Table 13 for mean frequency of OE questions over time by group and Figure 10 for mean frequency of OE questions over time.

Table 13. Mean OE Questions over Time by Group

<table>
<thead>
<tr>
<th></th>
<th>Observations</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td></td>
</tr>
<tr>
<td><strong>n</strong></td>
<td>50</td>
<td>9.81 (5.8)</td>
<td>12.35 (7.6)</td>
</tr>
<tr>
<td><strong>Comparison</strong></td>
<td>52</td>
<td>11.12 (7.3)</td>
<td>11.74 (6.2)</td>
</tr>
<tr>
<td><strong>TeachLivE</strong></td>
<td>102</td>
<td>10.45 (6.6)</td>
<td>12.05 (6.9)</td>
</tr>
</tbody>
</table>
**Question 3.4: OE+ questions.** An observer collected data on OE+ questions from the teacher, and two others observed 30% of classes to establish inter-rater reliability. Reliability of scores between observers during both observations was calculated (pre-intervention, $r = .586$; post-intervention, $r = .792$). Results from a mixed ANOVA indicated statistically significant changes in frequency of OE questions between Observation 1 and 2 based on treatment group ($F(1,100) = 2.223, p = .030, \eta^2_p = .046$). To determine the difference between groups at each level of time and vice versa, separate ANOVAs were run. There was no significant difference between treatment groups at Observation 1 ($F(1,102) = 2.402, p = .124, \eta^2_p = .023$) or Observation 2 ($F(1,100) = 2.223, p = .030, \eta^2_p = .046$). To determine the difference between groups at each level of time and vice versa, separate ANOVAs were run. There was no significant difference between treatment groups at Observation 1 ($F(1,102) = 2.402, p = .124, \eta^2_p = .023$) or Observation 2 ($F(1,100) = 1.699, p = .195, \eta^2_p = .017$). For the comparison group, OE+ was statistically significantly different between observations ($F(1,49) = 5.512, p = .023, \eta^2_p = .101$), with teachers significantly decreasing OE+ from Observation 1 ($M = .96, SD = 1.93$) to Observation 2 ($M = .36, SD = .69$). For the TeachLivE group, OE+ was not statistically significantly different between observations ($F(1,51) = .323, p = .572, \eta^2_p = .006$), although teachers increased from Observation 1 ($M = .50, SD = .90$) to Observation 2 ($M = .62, SD = 1.21$). See Table 14 for mean OE+ questions over time by group and Figure 11 for mean frequency of OE+ questions over time.

![Figure 10. Frequency of OE Questions over Time](image-url)
### Table 14. Mean OE+ Questions over Time by Group

<table>
<thead>
<tr>
<th></th>
<th>Observations</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>1 (M)</td>
<td>2 (M)</td>
</tr>
<tr>
<td>Comparison</td>
<td>50</td>
<td>.96 (1.9)</td>
<td>.36 (1.7)</td>
</tr>
<tr>
<td>TeachLivE</td>
<td>52</td>
<td>.50 (1.9)</td>
<td>.62 (1.2)</td>
</tr>
<tr>
<td>Total</td>
<td>102</td>
<td>.73 (1.5)</td>
<td>.49 (1.0)</td>
</tr>
</tbody>
</table>

### Figure 11. Frequency of OE+ over Time

#### Research question 4: Classroom results of simulation without feedback performance.

An observer collected data on CRA asked by the teacher, and two others observed 30% of classes to establish inter-rater reliability. Reliability of scores between observers during both observations was calculated (pre-intervention, $r = .931$; post-intervention, $r = .385$), and results should be interpreted with caution due to low reliability scores at post-observation. Results from a mixed ANOVA indicated there were no statistically significant changes in frequency of CRA between Observation 1 and 2 based on treatment group ($F(1,100) = .127, p = .722, \eta^2 p = .001$). See Table 15 for mean CRA over time by group and Figure 12 for mean frequency of CRA over time.

### Table 15. Mean CRA over Time by Group

<table>
<thead>
<tr>
<th></th>
<th>Observations</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>1 (M)</td>
<td>2 (M)</td>
</tr>
<tr>
<td>Comparison</td>
<td>50</td>
<td>5.12 (5.4)</td>
<td>4.78 (3.9)</td>
</tr>
<tr>
<td>TeachLivE</td>
<td>52</td>
<td>5.42 (5.2)</td>
<td>4.65 (5.4)</td>
</tr>
<tr>
<td>Total</td>
<td>102</td>
<td>5.27 (5.3)</td>
<td>4.71 (4.7)</td>
</tr>
</tbody>
</table>
Research question 5: What are the perceptions of practicing teachers related to presence and perceptions of presence after completing TeachLivE? Teachers who received TeachLivE were administered a questionnaire that gathered information about their perceptions of authenticity in the simulator. As with Phase I, the large majority (76.9%) of teachers in Phase II agreed that the classroom simulator felt like a real classroom. Also in alignment with results from Phase I, most teachers (82.9%) agreed that the virtual students accurately represented the kinds of people that exist in the real world.

Discussion

This study was the second phase of a two-phase project. In Phase I, middle school mathematics teachers were grouped by school and randomly assigned to one of four treatment conditions with varying levels of professional learning. Teachers were observed in their classrooms teaching the lesson and content of their choice, and teachers who received TeachLivE were observed in the classroom simulator. Results indicated that four 10-minute sessions in TeachLivE significantly improved targeted teaching behaviors in the simulator scenarios, and that these improvements transferred into the teachers’ original classroom settings. In Phase II, participants were primarily high school science teachers, and various refinements to methods occurred, including a reduction from four treatment groups to two (teachers who received lesson resources and teachers who received simulation) and uniform delivery of lesson plans.

As with Phase I, teachers overwhelmingly agreed that the classroom simulator felt like a real classroom and that the students also represented the kinds of students that existed in the real world. In terms of teacher practice, results from Phase I were replicated, in that teachers significantly increased targeted teaching practices in the simulator (OE+ questions) and improvements transferred into the teachers’ original classroom settings for OE questions. For
OE+ questions, while there was a significant increase in the simulator, those effects did not carry over to the real classroom, and this was unanticipated. In the classroom, although teachers who received simulation increased their frequency of OE+ questions, they did not do so significantly. It is interesting to note that their colleagues who did not receive simulation significantly decreased their frequency of OE+ questions from observations 1 to 2. Both groups were observed teaching the same lesson, so it is possible that the differences in performance can be attributed to practice in the simulator. Hattie and Timperley (2007) indicated that the impact of feedback was largest when relative to performance on a specific task with low complexity. It is possible that the feedback model resulted in less impact on OE+ questions because of the level of complexity. It is also possible that teachers who received simulation focused on too many performance objectives (OE and OE+ questions) and this resulted in a challenge to learning, reflected in the classroom when they only significantly changed practice related to one variable (OE questions). Consequently, the feedback model should be investigated to determine the best approach for impacting performance.

Consistent with Phase I, no significant difference in performance was observed in teachers’ classrooms when participants did not set performance objectives on a variable (CE questions). Looking back to teacher performance in the simulator, CE questions decreased significantly, which was expected, because teachers were focusing on increasing on opposing behavior of OE questions. Finally, consistent with Phase I, when teachers were not provided with feedback on a variable (CRA), no significant difference in performance was observed. This is not surprising, as many researchers indicate that setting objectives and providing feedback are essential components to improving teacher performance (Hattie & Timperley, 2007). Our work underscores the importance of providing a structured after-action-review that takes into account best practices for providing feedback on performance. As we saw in Phase I and II, when teachers did not receive data on their performance, they did not change their practice.

As a whole, results validated emerging research in the field that suggests that professional learning in mixed-reality simulated classrooms can be effective. We found support for our hypothesis that simulation would increase teachers’ frequency of OE questions and that this increase would also be observed in their classrooms. Teachers who took part in a series of sessions significantly increased their instances of OE+ questions in the simulator, similar to studies conducted earlier (e.g., Dawson & Lignugaris/Kraft, 2013; Elford et al., 2013; Garland et al., 2012), and their performance in OE questions also increased significantly in comparison to colleagues who did not receive simulation. Overall, findings from Phase I of this study were replicated in Phase II, providing support for our overarching hypothesis that teachers who engage in TeachLivE professional development can improve their pedagogical knowledge.

Limitations

In Phase I, limitations to internal validity resulted from the nested design in which teachers were grouped by school, because teachers within one school day may be more similar than teachers across schools. However, in Phase II, random assignment occurred at the teacher level, rather than the school level, based on the idea that performance in a simulator was individualized and that threats to validity as a result of treatment diffusion (i.e., treatment effects spreading from one group to another) were unlikely. This random assignment at the teacher level allowed for balancing of similarities within each school. However, as with Phase I, the original research design was a randomized trial, yet the nature of the design changed as a
consequence of teacher requests to change initial treatment conditions. In each case, teachers remained in the study but reported that they would only participate if allowed to change treatment groups \((n = 7)\). This phenomenon violated random assignment and changed the research design to a quasi-experiment.

There were other threats to data reliability, and confounding factors. In Phase I, classroom observation data had low reliability, so operational definitions were revised and data collection training was improved to increase reliability of results. Data collectors engaged in more rigorous group coding activities, and data met reliability thresholds (75% or better) in almost all variables at observations 1 and 2. Most significantly, in Phase I, classroom instruction was not standardized by a common lesson, so content and format varied widely. In Phase II, this confounding variability was removed in that all teachers taught a common lesson at each observation, providing a stronger basis for comparison.

Of the 11 research sites, only 1 was in the school setting. At this site, a researcher brought the simulation equipment to the teachers’ school using a mobile unit. This took a significant amount of coordination between technology staff on the research team and with the district, as the software requires specific network settings. At the other 10 sites, teachers traveled to the simulation sites located at institutes of higher education. Teachers receiving simulation were required to visit the simulator three times, which required significant scheduling efforts in the cases of last minute cancellations or delays resulting from technology issues. Cancellations due to travel were not an issue for the mobile lab; however, new barriers to scheduling arose, as teachers were more likely to run late to sessions as they tried to juggle on-site job duties. Future research should explore the idea of school district-level coordination for professional learning so teachers do not have competing demands for their attention.

**Future Research and Implications**

Findings from this study can be generalized to other high school science teachers who receive four 10-minute sessions of TeachLivE with after-action-review. Because results were replicated from Phase I to II, the next important step is to evaluate the impact of varying durations, frequency, and total number of simulations to determine the optimal level of treatment to produce the desired results. This question of dosage is critical to unlocking the benefits of simulation for busy teachers and school districts with limited financial resources; simulation has the potential to deliver professional learning in an accelerated format, on site at schools, and in a compressed amount of time. Identifying the components of effective simulation will save valuable time and money. In light of findings from Phases I and II, the team currently has three areas related to time to further research. First, if four 10-minute sessions impact practice, how long does this change in practice continue? Second, what is the optimal frequency of practice over time to ensure retention of new skills acquired in the simulator? Or, in other words, do teachers need to re-visit the simulator to practice once a month, semester, or year? Third, in both Phase I and II, a pattern was observed: after about five to seven minutes of working on a new skill, teachers tend to fall back to patterns of old behavior. Early work is being done to establish whether shorter sessions result in a significant increase in practice as we explore the motivational value of adding micro-credentials for reaching goals with specific high-level practices.

Our findings have more important implications for researchers and educators designing simulation activities, since simulation with no feedback is likely a waste of resources. The
simulation after-action-review model should be examined in a component analysis to identify best practices for simulation integrated with feedback. In both Phases I and II, the researchers found that teachers did not change their performance when no feedback was provided. A basic understanding is emerging that feedback in simulation is essential, but future research should explore the aspects of after-action-review to determine the most effective model.

Just as models of feedback need further investigation, so do methods of grouping teacher participants in the simulator. For this project, teachers attended sessions individually, resulting in the most costly use of the simulator. Would it be more effective for teachers to attend simulation activities in small groups (lesson studies or even Professional Learning Communities) with the twofold benefit of capitalizing on the social nature of learning and cost-savings? School districts and teacher preparation institutes seeking to save on simulation budgets are interested in learning if grouping individuals enhances or degrades the simulation experience; more people could be trained if group models are beneficial. While questions surrounding group versus individual models of training were not explored in this project, there is much interest in the impact of these competing formats since understanding their relative benefits can further inform the field as more simulation technology is used for teacher learning.

As we continue to collect data to support the use of simulation in teacher education, we are also interested in the impact of simulation in other domains. Our future work for Phase III of this project explores the use of simulation with adult avatars for other educational professionals such as administrators, guidance counselors, psychologists, and counselor educators. Use of simulation for parent-teacher conferences can provide invaluable experiences for professionals who likely did not engage with parents during their clinical field experiences or at any time during their preparation programs. Simulation can provide a safe practice ground so individuals can learn from mistakes without harming relationships with parents. In counselor education, practice in challenging interactions with adult avatars could teach techniques for counseling. Because teachers report that the mixed-reality simulation feels authentic to teaching, the same feelings of authentic presence will likely occur in adult avatar interactions. The expansion to this space is a large potential area of exploration, as more and more sites express interest in using adult avatars for difficult conversations.

Beyond educational professionals’ use of simulation, we are highly interested in how simulation might be used to impact student learning. As part of Phase III of our research, we are investigating social skill interactions for students with autism, and problem-solving skills for students with intellectual disabilities.

Our findings support the theory that simulated learning environments are efficient for learning and practicing new teaching strategies. We have found that four 10-minute sessions on a specific teaching skill can change teacher behavior not only in the simulator with student-avatars, but also in the classroom with real students. Teachers have the opportunity to practice, make mistakes, and try new approaches in a safe place for teachers and students. As we explore the next generation of tools for teachers’ professional and personalized learning, we keep in mind that the ultimate goal of the research team is not to replace “real” teaching, but instead allow for safe, fun, targeted and personalized practice. Our vision is to use simulators to prepare and retool the skills of teachers at all levels from pre-service to in-service, and the skills of individuals in other domains whose interactions are complex and nuanced like the act of teaching.
References


APPENDIX A: LESSON FOR OBSERVATION 1
What is Technology?

First Observation

Overview
This lesson involves classroom discussion and a short scenario to allow students to develop a sense of what technology is, dispel the notion that technology relates mostly to computers, and examine the impact of technology. The lesson is designed to enhance science literacy and is aligned with Disciplinary Core Ideas and Cross-cutting Concepts from the Next Generation Science Standards, as well as the Common Core Standards for Literacy in Science. The lesson is based on the 5E Instructional Model and has been validated and field-tested in high school Biology classrooms as part of a larger module from the NIH Curriculum Supplement Series “Using Technology to Study Cellular and Molecular Biology” which can be found in its entirety online at http://science.education.nih.gov/supplements/nih4/technology/guide/nih_technology_curr-supp.pdf

Major Concepts
Technology is a body of knowledge used to create tools, develop skills, and extract or collect materials. It is also the application of science (the combination of the scientific method and material) to meet an objective or solve a problem.

Standards-based Objectives
- be able to explain what technology is
- recognize that human intervention is the common bond among technological ecosystems
- use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales
- evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts

Standards
See Appendix A for detailed list of standards.
Before Class

1. Follow instructions to fill out the **Cross-Reference Demographics Sheet**

2. Administer the **Student Assessment**

3. For the lesson, make sure you have a copy for each student:
   - Handout 1.1: BEFORE Lesson Concept Map (white paper)
   - Handout 1.2: Estimated No. of Polio Cases per Year & Timeline (white paper)
   - Handout 1.3: AFTER Lesson Concept Map (yellow paper)

4. Be prepared to give the following to the observer at the end of the first observation:
   - Cross-Reference Demographics Sheet
   - Handout 1.1: BEFORE Lesson Concept Map for each student
   - Handout 1.3: AFTER Lesson Concept Map for each student
   - Student Assessment for each student

Materials

Have a set of all three handouts for each student:
- Handout 1.1: BEFORE Lesson Concept Map (white paper)
- Handout 1.2: Estimated No. of Polio Cases per Year & Timeline (white paper)
- Handout 1.3: AFTER Lesson Concept Map (yellow paper)

This lesson includes science literacy mini-tasks embedded throughout the lesson. Look for the Literacy Design Collaborative (LDC) logo to see the location of science literacy mini-tasks. For more information about increasing science literacy, visit the LDC at http://www.literacydesigncollaborative.org/. The LDC offers a framework for building the college-and-career-ready literacy skills specified by the Common Core State standards.

Procedure

**Pre-Lesson:**

10 minutes

Before the lesson, pass out **Handout 1.1: BEFORE Lesson Concept Map** (white paper). Have students follow instructions to create student codes. While the students are completing their codes, draw a model concept map on the board that looks like this:

After you have drawn the model and have students’ attention, say:

“This is a concept map. It is used for understanding concepts and relationships. A general topic/question is in the circle at the top of the map. Write the more specific concepts that relate in some way to the general concept. Tie the general and specific concepts together with linking words in some way that makes sense or has meaning to you. Look for cross-linkages between the general and more specific concepts. You have 5 minutes to generate as many ideas as you can.”

After 5 minutes, collect the maps and then begin the lesson.
Part 1: 10 minutes

1. Begin by asking the class, “How do you define technology?”

Accept all answers and write student responses on the board. Do not attempt to have students refine their definitions of technology at this point. They will revisit their definitions and refine them later.

Students, like older individuals, may harbor the preconception that technology relates mostly to computers. Through advertisements and media articles, they are familiar with the terms information technology and computer technology.

Teacher note: Asking this question requires students to call on their prior knowledge, and it engages their thinking. As this point, do not critique student responses. Appropriate teacher comments are short and positive, such as “good” and “what else?” Other appropriate teacher responses include, “Why do you believe that?” or “How do you know that?” Questions such as these allow the teacher to assess students current knowledge about the subject and to adjust lessons accordingly. They also provide a springboard to “Let’s find out” or “Let’s investigate.” In general, it is time to move forward when you see that thinking has been engaged.

2. Ask students, “In general, what does technology do for us?”

This question may help students understand that technology helps us solve problems, makes our lives easier, and extends our abilities to do things. Technology is used to develop skills or tools, both in our daily lives and in our occupations.

Enrichment: If students bring up the term ecosystem, as it may pertain to past biology concepts, it is appropriate to discuss ecosystems.

3. Focus discussion on technologies that are relevant to each student’s life. Ask students to look around the room. What technologies do they see? How do these technologies solve problems and make their lives easier in society, culture, and the environment?

Accept all responses and write them on the board. Students may mention any number of items. Some may be school-related, such as binders, backpacks, pens, pencils, paper, and paper clips. Other items may be more personal, such as water bottles, personal stereos, and hair clips. Students may neglect items such as shoelaces, zippers, buttons, fabric, eyeglasses or contact lenses, makeup, and bandages. Discussion should reinforce the notion that humans develop technology with a specific objective in mind. A related concept is that a give task requires the right tool or tools.

4. Turn the discussion to how technology has impacted major world problems such as disease. Ask “What diseases have been impacted by technology?” and have students talk in small groups, before discussing as a whole class.

After a brief discussion as a class, tell students they will now use mathematics to support explanations using data from the Bill & Melinda Gates Foundation about technology and the number of cases of polio worldwide.

Misconception Alert: At this point in the discussion, you may need to clarify the concept of viruses and bacteria for students.
Part 2: 15 minutes

5. Pass out *Handout 1.2: Estimated Number of Polio Cases per Year & Timeline* (white paper copies provided). Explain to students you are now going to talk about a specific disease and theorize how technology impacted polio.

6. Ask students to read *Handout 1.2* and ask, “How do you interpret the trend in estimated number of polio cases per year?”

Students first should recognize that the estimated number of polio cases per year is decreasing. Bring attention to the embedded graph. Ask students, "Why do you think the creators of the graph decided to show the data in this way?" Students may have the misconception that the number of estimated cases in 2000 was similar to that of 1989, because of how the data are displayed and the scale that is used. Have students pay attention to the y-axis.

7. Ask students to read *Handout 1.2*. Ask, “How can evidence from the graph or timeline be used to make claims about technology’s impact on polio?”

Student responses will vary, and some students may want to look for events which correspond exactly to years on the graph when polio cases showed a dramatic decrease. Students may also note that the data begins in 1988 when the Global Polio Eradication Initiative was launched. They may note that the years in the graph are not the same as the years in the timeline, providing the opportunity to discuss the limitations of data sets. Slow them down and have them consider cumulative changes in knowledge and technologies. Advances in microbiology and chemistry contributed to development of vaccines over time. Innovations such as the iron lung were early technological advances for polio. Students should derive and understanding that a relationship exists between problems and the technology to solve it.

8. On the basis of previous discussion, ask the students to rethink and refine their definition of technology (from Step 1), including its impact on society, culture, and environment. Students should mention that technology is a way of solving problems through the application of knowledge from multiple disciplines.

### Post-Lesson: 10 minutes

LDC Mini-task: *Lesson Reflection.*

The concept map activity at the end of the lesson facilitates review, reflection, elaboration, and consolidation of student understanding.

After the lesson, pass out *Handout 1.3: AFTER Lesson Concept Map* (yellow paper). Have students follow instructions to create student codes. While the students are completing their codes, draw a model concept map on the board that looks like this:

After you have drawn the model and have students’ attention, say:

“This is a concept map. It is used for understanding concepts and relationships. A general topic/question is in the circle at the top of the map. Write the more specific concepts that relate in some way to the general concept. Tie the general and specific concepts together with linking words in some way that makes sense or has meaning to you. Look for cross-linkages between the general and more specific concepts. You have 5 minutes to generate as many ideas as you can.”

After 5 minutes, collect the maps and give all documents to the observer.
Appendix A: Standards

Students who demonstrate understanding can:
Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales (Biology Domain and Biology Repeat HS-LS2-2).
Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts (Biology Domain and Crosscutting Concept with Chemistry, Physics, and Earth & Space Science HS-ETS1-3).

Students who demonstrate understanding can:
CCSS.ELA-Literacy.RST.11-12.9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
CCSS.ELA-Literacy.SL.9-10.1c. Propose conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.
CCSS.ELA-Literacy.SL.9-10.1d. Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.
CCSS.ELA-Literacy.SL.9-10.4. Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
CCSS.ELA-Literacy.CCRA.SL.1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others‘ ideas and expressing their own clearly and persuasively.
CCSS.ELA-Literacy.CCRA.SL.2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
CCSS.ELA-Literacy.CCRA.SL.3. Evaluate a speaker’s point of view, reasoning, and use of evidence and rhetoric.
What does technology do for us?

Teacher Code Sample:

1. Write your three-letter initials (if no middle initial, use the second letter of your first name):
   ________  ________  ________

2. Circle the Day of the month you were born: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Follow the instructions below to create student codes:
Handout 1.2: Estimated Number of Polio Cases per Year & Timeline

Polio Timeline

3000 BC
Egyptian paintings and carvings depict people with withered limbs and walking with canes

1928
First iron lung used at Children’s Hospital in Boston

1952
Worst polio outbreak in the United States history, with 658,000 reported cases

1963
Albert Sabin’s oral polio vaccine licensed

1979
Last case of naturally occurring polio in the United States

2007
The World Health Organization declares polio eradicated in the Americas, Europe, and the Western Pacific.

1970s
National immunization programs launched leading to control of the disease in many developing countries

1988
Polio still exists in 125 countries and paralyzes an estimated 350,000 children; Global Polio Eradication Initiative created

2010
Sustained transmission of polio in four countries, but outbreaks in 16 countries are reminders that polio anywhere is a threat everywhere

Concept Map

Instructions:
Wait for your teacher's signal to begin.

What does technology do for us?

This is a concept map. It is used for understanding concepts and relationships. A general topic/question is in the circle at the top of the map. Write the more specific concepts that relate in some way to the general concept. Tie the general and specific concepts together with linking words in some way that makes sense or has meaning to you. Look for cross-linkages between the general and more specific concepts.

1. Write your three-letter initials (if no middle initial, use the second letter of your first name):

2. Circle the day of the month you were born:

   1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Students: Follow the instructions below to create student codes:
APPENDIX B: LESSON FOR OBSERVATION 2
Overview
This lesson involves classroom discussion and examination of a biological modeling system using technology. The lesson is designed to enhance science literacy and is aligned with Disciplinary Core Ideas and Cross-cutting Concepts from the Next Generation Science Standards, as well as the Common Core Standards for Literacy in Science. The lesson is based on the 5E Instructional Model and has been validated and field-tested in high school Biology classrooms as part of a larger module from the NIH Curriculum Supplement Series “Using Technology to Study Cellular and Molecular Biology” which can be found in its entirety online at http://science.education.nih.gov/supplements/nih4/technology/guide/nih_technology_curr-supp.pdf

Major Concepts
The process of modeling biological systems involves the use of computer simulations to analyze and visualize complex processes. Computers are widely used today to simulate a system’s response to internal and external stimuli. The goal of modeling is to create accurate, real-time models.

Standards-based Objectives
After completing this lesson, students will:
- be able to explain what modeling is
- recognize that as technologies change, so do our modeling capabilities
- use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales
- evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts

Standards
See Appendix A for detailed list of standards.
Before Class

1. Follow instructions to fill out the Cross-Reference Demographics Sheet
2. Administer the Student Assessment
3. For the lesson, make sure you have a copy for each student:
   - Handout 2.1: BEFORE Lesson Concept Map (blue paper)
   - Handout 2.2: Annual U.S. Flu Activity (white paper)
   - Handout 2.3: AFTER Lesson Concept Map (pink paper)
4. Be prepared to give the following to the observer at the end of the first observation:
   - Cross-Reference Demographics Sheet
   - Handout 2.1: BEFORE Lesson Concept Map for each student
   - Handout 2.3: AFTER Lesson Concept Map for each student
   - Student Assessment for each student

Materials

Have a set of all three handouts for each student:
- Handout 2.1: BEFORE Lesson Concept Map (blue paper)
- Handout 2.2: Annual U.S. Flu Activity (white paper)
- Handout 2.3: AFTER Lesson Concept Map (pink paper)

This lesson includes science literacy mini-tasks embedded throughout the lesson. Look for the Literacy Design Collaborative (LDC) logo to see the location of science literacy mini-tasks. For more information about increasing science literacy, visit the LDC at http://www.literacydesigncollaborative.org/. The LDC offers a framework for building the college-and-career-ready literacy skills specified by the Common Core State standards.

Procedure

Pre-Lesson:
10 minutes

Before the lesson, pass out Handout 2.1: BEFORE Lesson Concept Map (blue paper). Have students follow instructions to create student codes. While the students are completing their codes, draw a model concept map on the board that looks like this:

After you have drawn the model and have students’ attention, say:
“This is a concept map. It is used for understanding concepts and relationships. A general topic/question is in the circle at the top of the map. Write the more specific concepts that relate in some way to the general concept. Tie the general and specific concepts together with linking words in some way that makes sense or has meaning to you. Look for cross-linkages between the general and more specific concepts. You have 5 minutes to generate as many ideas as you can.”

After 5 minutes, collect the maps and then begin the lesson.
Part 1: 10 minutes  
1. Begin by writing on the board, “Technology is a means of extending human potential or of extending human senses.” Ask students, “Who agrees or disagrees with this statement and why?” Ask students, “What specific technologies can you relate to the extension of human attributes or senses?”

Students will generally agree that technology extends human potential. Obvious examples include the wheel and other transportation innovations that extend out potential for movement, and electronic devices such as TV, radio, and telephones, that extend our ability to communicate. Microscopes, telescopes, eyeglasses, and contact lenses extend and enhance our sense of vision. Computers and written materials can be seen as ways to extend memory. Appropriate teacher comments are short and positive, such as “good” and “what else?” Others include, “Why do you believe that?” or “How do you know that?”

2. Ask students to consider only technologies that have increased our understanding of living systems. Ask, “What human attributes are extended?”

Students will probably focus on those that extend vision, since they are the easiest to recognize. Examples could include radar, eyeglasses, contact lenses, and telescopes. Other technologies might be mentioned. Accept all responses and write them on the board. This is an opportunity to identify students’ current understanding of these technologies.

3. Ask students, “How do data and technology extend what we know?” In steps 1 and 2, students will likely focus on technologies that extend human senses since they are the easiest to recognize.

4. Move the discussion to physical or computer models used to explain or detect phenomena. Ask “What physical or computer models have we discussed in class?” and have students talk in small groups before discussing as a whole class. The process of modeling biological systems involves the use of computer simulation is to extend what we know by analyzing and visualizing complex processes. Computers are widely used today to simulate a system’s response to internal and external stimuli. The goal of modeling is to create accurate, real-time models.

Part 2: 15 minutes  
5. Pass out Handout 2.2: Annual U.S. Flu Activity (blue paper copies provided) and explain that it shows two difference methods of gathering data using technology in order to detect influenza: the Center for Disease Control (CDC) and Google search engine terms (Google).

Explain CDC publishes national and regional data reported to them from physician’s offices on a weekly basis, typically with a 1-2 week reporting lag. In an attempt to provide faster detection, innovative surveillance systems have been created to monitor indirect signals of influenza, such as call volume to telephone triage advice lines and over-the-counter-drug sales. Google web search logs provide estimates that are current each day.
6. Ask students, "How do you interpret the trend lines of CDC versus Google?" and ask them to justify their answers: "What evidence do you see in the graphs?" Student responses will vary. Student should identify that the influenza-like illnesses (ILI) percentages are similar for CDC and Google from Figure 1. From Figure 2, they should note that the Google model received data at a faster pace. Ask the students, "How did technologies impact those findings?"

7. Turn the discussion to the importance of being able to detect illness such as influenza. Begin by asking students, "Why is using technology from early detection of a disease like influenza important to the community?"

Students should identify the benefits of early detection of influenza disease. Early detection of disease activity, when followed by a rapid response, can reduce the impact of both seasonal and pandemic influenza. Seasonal influenza epidemics are a major public health concern, causing tens of millions of respiratory illnesses and 250,000 to 500,000 deaths worldwide each year. Early detection of disease activity, when followed by a rapid response, can reduce the impact of both seasonal and pandemic influenza.


8. On the basis of previous discussion, ask the students to rethink how technology extends our human potential and senses, socially, culturally, and environmentally. Students should mention that models provide a way to detect relationships in systems.

After the lesson, pass out Handout 2.3: AFTER Lesson Concept Map (pink paper). Have students follow instructions to create student codes. While the students are completing their codes, draw a model concept map on the board that looks like this:

After you have drawn the model and have students’ attention, say:

“This is a concept map. It is used for understanding concepts and relationships. A general topic/question is in the circle at the top of the map. Write the more specific concepts that relate in some way to the general concept. Tie the general and specific concepts together with linking words in some way that makes sense or has meaning to you. Look for cross-linkages between the general and more specific concepts. You have 5 minutes to generate as many ideas as you can.”

After 5 minutes, collect the maps and give all documents to the observer.
Appendix A: Standards

Students who demonstrate understanding can:
Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales (Biology Domain and Biology Repeat HS-LS2-2).
Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts (Biology Domain and Crosscutting Concept with Chemistry, Physics, and Earth & Space Science HS-ETS1-3).

Students who demonstrate understanding can:
CCSS.ELA-Literacy.RST.11-12.9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
CCSS.ELA-Literacy.SL.9-10.1c Propose conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.
CCSS.ELA-Literacy.SL.9-10.1d Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.
CCSS.ELA-Literacy.SL.9-10.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
CCSS.ELA-Literacy.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others’ ideas and expressing their own clearly and persuasively.
CCSS.ELA-Literacy.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
CCSS.ELA-Literacy.CCRA.SL.3 Evaluate a speaker’s point of view, reasoning, and use of evidence and rhetoric.
How does technology extend our potential?

Instructions:
Wait for your teacher's signal to begin.

This is a concept map. It is used for understanding concepts and relationships. A general topic/question is in the circle at the top of the map. Write the more specific concepts that relate in some way to the general concept. Tie the general and specific concepts together with linking words in some way that makes sense or has meaning to you. Look for cross-linkages between the general and more specific concepts.

1. Write your three-letter initials (if no middle initial use the second letter of your first name):

2. Circle the day of the month you were born: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Students - Follow the instructions below to create student codes:
Handout 2.2: Annual U.S. Flu Activity

Figure 1

Center for Disease Control (CDC) Method: collects physician visits data and publishes weekly

Google Method: collects search terms daily

ILI = influenza-like illness
Google = Black line
CDC = Red Line

Figure 2

How does technology extend our potential?

Instructions:
Wait for your teacher’s signal to begin.

This is a concept map. It is used for understanding concepts and relationships. A general topic/question is in the circle at the top of the map. Write the more specific concepts that relate in some way to the general concept. Tie the general and specific concepts together with linking words in some way that makes sense to you. Look for cross-linkages between the general and more specific concepts.

1. Write your three-letter initials (if no middle initial, use the second letter of your first name):

2. Circle the DAY of the month you were born: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Students - Follow the instructions below to create student codes:
APPENDIX C: CONCEPT MAP DIRECTIONS
**Handout 1.1 Instructions – White Paper**

Before the lesson, pass out *Handout 1.1: BEFORE Lesson Concept Map* (white paper). Have students follow instructions to create student codes. While the students are completing their codes, draw a model concept map on the board that looks like this:

After you have drawn the model and have students’ attention, say:

“This is a concept map. It is used for understanding concepts and relationships. A general topic/question is in the circle at the top of the map. Write the more specific concepts that relate in some way to the general concept. Tie the general and specific concepts together with linking words in some way that makes sense or has meaning to you. Look for cross-linkages between the general and more specific concepts. You have 5 minutes to generate as many ideas as you can.”

After 5 minutes, collect the maps and then begin the lesson.

**Handout 1.3 Instructions – Yellow Paper**

After the lesson, pass out *Handout 1.3: AFTER Lesson Concept Map* (yellow paper). Have students follow instructions to create student codes. While the students are completing their codes, draw a model concept map on the board that looks like this:

After you have drawn the model and have students’ attention, say:

“This is a concept map. It is used for understanding concepts and relationships. A general topic/question is in the circle at the top of the map. Write the more specific concepts that relate in some way to the general concept. Tie the general and specific concepts together with linking words in some way that makes sense or has meaning to you. Look for cross-linkages between the general and more specific concepts. You have 5 minutes to generate as many ideas as you can.”

After 5 minutes, collect the maps and give all documents to the observer.
APPENDIX D: TEACHER PRACTICE OBSERVATION TOOL (TPOT)
<table>
<thead>
<tr>
<th>Are you a certified teacher?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is classroom teacher planning to teach appropriate NIH lesson?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Is a co-teacher teaching too?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>If yes, who taught majority of lesson?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did teacher follow BEFORE concept map procedures?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Did teacher follow AFTER concept map procedures?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

**Instructions:** *Wait exactly 5 minutes* after bell rings to start audio and begin. If entire interval is inaudible, in the cell mark an X.

- **Danielson:** For 1 min, look at Danielson constructs coming up. Don't collect data.
- **Questions:** For 3 min, collect frequency counts on type of questions.
- **Affirmation:** For 3 min, collect frequency counts on specific affirmation, while collecting student talk in secs using stopwatch. Do not reset.
- **Field Log:** For 2 min, write at least 1 note & check 1 box about each practice.

- **Closed-Ended Questions**
- **Comments**

<table>
<thead>
<tr>
<th>Interval 1</th>
<th>Open-ended and Open-ended+</th>
<th>Closed-Ended Questions</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danielson:</td>
<td>1 min</td>
<td>Managing Student Behavior &amp; Managing Classroom Procedures</td>
<td></td>
</tr>
<tr>
<td>Questions:</td>
<td>3 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affirmation:</td>
<td>3 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student Talk</td>
<td>Duration in seconds (do not reset, continue on next interval):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Log</td>
<td>2 min: <em>Write at least one note about practice per area then check appropriate box. Provide comments to justify rating.</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Managing Student Behavior:
- □ no established standards of conduct
- □ inconsistent standards of conduct
- □ teacher established standards
- □ students self-monitor with standards

### Managing Classroom Procedures:
- □ much instructional time is lost
- □ some instructional time is lost
- □ little loss of instructional time
- □ time is maximized

<table>
<thead>
<tr>
<th>Interval 2</th>
<th>Open-ended and Open-ended+</th>
<th>Closed-Ended Questions</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danielson:</td>
<td>1 min</td>
<td>Establishing a Culture for Learning &amp; Engaging Students in Learning</td>
<td></td>
</tr>
<tr>
<td>Questions:</td>
<td>3 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affirmation:</td>
<td>3 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student Talk</td>
<td>Duration in seconds (continue from last interval):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Log</td>
<td>2 min: <em>Write at least one note about practice per area then check appropriate box. Provide comments to justify rating.</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Establishing a Culture for Learning:
- □ lack of commitment to learning
- □ little commitment to learning
- □ high expectations by teacher
- □ shared belief in importance

### Engaging Students in Learning:
- □ few engaged
- □ some engaged
- □ most engaged
- □ virtually all highly engaged
### Field Log

**2 min:** *Write at least one note about practice per area then check appropriate box. Provide comments to justify rating.*

#### Communicating with students:

- explanations confusing or with errors
- explanations initially confusing
- explanations clearly communicated
- explanations clear & anticipate confusion

#### Using questioning and discussion techniques:

- a few students respond
- some students discuss
- teacher engages most students
- students extend discussion

#### Creating an environment of respect and rapport:

- mostly negative interactions
- generally appropriate interactions
- general caring and respect
- genuine warmth and caring

#### Using assessment in instruction:

- little or none
- used sporadically
- used regularly
- fully integrated (formative assessment)
Final Summary Check:
1. Now that you have completed the full observation, write brief statements of the teacher's practice in the space provided below.
2. Choose the final level by checking one box within each category and be sure to provide justification for your rating.
3. If you are conducting this observation with another rater for inter-rater reliability, you may then discuss your chosen levels.
4. After your conversation, you may choose to make a change to one of the levels below.
5. If you choose to make a change, please provide a justification.
6. No changes may be made to the frequency counts or the field logs on pages 1-2.

| Managing student behavior:                               | □ no established standards of conduct |
|                                                           | □ inconsistent standards of conduct  |
|                                                           | □ teacher established standards      |
|                                                           | □ students self-monitor with standards |
| Managing classroom procedures:                           | □ much instructional time is lost    |
|                                                           | □ some instructional time is lost    |
|                                                           | □ little loss of instructional time  |
|                                                           | □ time is maximized                  |
| Establishing a culture for learning:                     | □ lack of commitment to learning     |
|                                                           | □ little commitment to learning      |
|                                                           | □ high expectations by teacher       |
|                                                           | □ shared belief in importance        |
| Engaging students in learning:                           | □ few engaged                        |
|                                                           | □ some engaged                       |
|                                                           | □ most engaged                       |
|                                                           | □ virtually all highly engaged       |
| Communicating with students:                             | □ explanations confusing or with errors |
|                                                           | □ explanations initially confusing   |
|                                                           | □ explanations clearly communicated  |
|                                                           | □ explanations clear & anticipate confusion |
| Using questioning and discussion techniques:             | □ a few students respond             |
|                                                           | □ some students discuss              |
|                                                           | □ teacher engages most students      |
|                                                           | □ students extend discussion         |
| Creating an environment of respect and rapport:          | □ mostly negative interactions       |
|                                                           | □ generally appropriate interactions |
|                                                           | □ general caring and respect         |
|                                                           | □ genuine warmth and caring          |
| Using assessment in instruction:                         | □ little or none                     |
|                                                           | □ used sporadically                  |
|                                                           | □ used regularly                     |
|                                                           | □ fully integrated (formative assessment) |

Student Talk (final number on stopwatch cumulative across lesson) in seconds: ________________________
APPENDIX E: OPERATIONAL DEFINITIONS QUICK REFERENCE SHEET
**Closed-ended question:** A content question which has restricted parameters, expecting one possible response as its acceptable answers. A question which constrains a student's response such as test questions, yes–no questions and forced choice questions.

<table>
<thead>
<tr>
<th>Example</th>
<th>Non-examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Which is more essential: a computer or a phone?&quot;</td>
<td>&quot;What knowledge is required to create a computer?&quot; (open)</td>
</tr>
<tr>
<td>&quot;Does anyone know what technology is?&quot;</td>
<td>&quot;How do you define technology?&quot; (open)</td>
</tr>
<tr>
<td>&quot;Do you have any ideas?&quot;</td>
<td>Do not code: &quot;...Ok?&quot; &quot;...Right?&quot; &quot;...Alright?&quot; &quot;...Huh?&quot;</td>
</tr>
<tr>
<td>&quot;Do you want to expand on that?&quot; or &quot;Is that right?&quot;</td>
<td>When a teacher calls on a student and says “Yes...”</td>
</tr>
<tr>
<td>&quot;Anything else?&quot; or &quot;Anybody else?&quot;</td>
<td>Also, do not code statements made with questioning intonation.</td>
</tr>
<tr>
<td>&quot;How many of you think so?&quot;</td>
<td></td>
</tr>
</tbody>
</table>

**Open-ended Question:** A content question to which a number of different answers would be acceptable. A content question which has no parameters and does not constrain student’s response.

<table>
<thead>
<tr>
<th>Example</th>
<th>Non-examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;What is your personal definition of technology?&quot;</td>
<td>Yes-no questions that the teacher intends as open-ended questions are still coded as closed-ended questions: “Can anyone tell me what technology is?” and “Do you have any examples of technology?” are yes/no questions and should be coded as closed-ended.</td>
</tr>
<tr>
<td>&quot;How does technology help us in our everyday lives?&quot;</td>
<td>&quot;How does technology help us in our everyday lives?&quot;</td>
</tr>
<tr>
<td>&quot;What else?&quot;</td>
<td>&quot;How does technology help us in our everyday lives?&quot;</td>
</tr>
<tr>
<td>&quot;How else?&quot;</td>
<td>&quot;How else?&quot;</td>
</tr>
</tbody>
</table>

**Open-ended Question Plus:** A content question that asks a student to extend, produce, or combine ideas to generate new ideas (related to Bloom's highest Cognitive domain – Creating).

After coding OE, if it is OE+, write a horizontal line over tally mark to make it look like a plus sign: [ ] [ ] [ ] [ ] [ ]

<table>
<thead>
<tr>
<th>Example</th>
<th>Non-examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;How would you prove that, using evidence from our activity in class today?&quot;</td>
<td>&quot;Why does the boat float?&quot; (this is open-ended, because the response is not restrained, but it does not require students to combine ideas to generate new knowledge).</td>
</tr>
<tr>
<td>&quot;How could you use today’s technology to create transportation for people with limited visibility?&quot;</td>
<td>&quot;How could you use today’s technology to create transportation for people with limited visibility?&quot;</td>
</tr>
<tr>
<td>&quot;How do you think people will use this tool in 50 years?&quot;</td>
<td>&quot;How do you think people will use this tool in 50 years?&quot;</td>
</tr>
</tbody>
</table>

**Questioning - Points to Remember:**
- A question is a question, so count them all, but only content-related questions are considered.
- Wait for the end of question; sometimes questions change midway.
- If the teacher asks a string of questions, code each complete one individually.
- The type of question is determined by the literal response requested by the teacher. Do not attempt to identify teacher’s intent (e.g., “Does anyone else have an idea?” is a yes/no question even though the teacher is soliciting more responses. Student can choose to simply say “No”).

**Questioning - Background:** Checking for student understanding during a lesson using informal assessment techniques (METEX TW13). Eliciting and interpreting individual students’ thinking (High-leverage Practice #3).

**Student Talk:** Teacher is leading or facilitating a discussion among students; one or more students are contributing and focus is on content. Also occurs during student small-group work in which students have the opportunity to discuss content. A majority of students should be discussing content in their groups.

<table>
<thead>
<tr>
<th>Examples</th>
<th>Non-examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student responding to a question. Student asking a question. Student commenting on a peer’s idea. Small group discussions. If half of the groups are discussing content – count it.</td>
<td>Students’ off-task side conversations. Student discussion about topics not related to content. “When is the next school holiday?”</td>
</tr>
</tbody>
</table>

**Student Talk - Points to Remember:**
- If student and teacher talk is happening - count it as student talk (e.g. if teacher is meeting with other groups while students are discussing content),
- You will need a stopwatch to measure the amount of time students spend talking. Use the start/stop function to gather cumulative amount of time students spend talking on task during the interval. At the end of the observation, you should have the total time across all five intervals.

**Student Talk - Background:** In a whole class format, the entire class is talking, listening, or working together (METEX TW01). Teacher is leading or facilitating a discussion among students; several students are contributing, and teacher seeks to involve multiple children in listening and speaking. Discussion involves sustained interaction and is focused on a text, issues, problems, or questions where the goal is to work on collective understanding, analysis, or solutions (METEX TW08). Leading a whole class discussion (High-leverage practice #2). Eliciting and interpreting individual students’ thinking (High-leverage Practice #3).

**Specific Affirmation:** Teacher’s positive verbal affirmation about what a student or group of students did or said related to content in a single episode within class (multiple statements about the same episode count as 1 occurrence of affirmation).

<table>
<thead>
<tr>
<th>Examples</th>
<th>Non-examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>“I like the way you described cell structure.”</td>
<td>“Good.” “Uh-huh.” “Yes. OK.” (not specific)</td>
</tr>
<tr>
<td>“Yes, Angie said we should add more items here and that is correct.”</td>
<td>“You are so smart” (not related to content). “OK, very good. Thank you” (not specific).</td>
</tr>
<tr>
<td>“Nice observation.”</td>
<td>Do not code: Teacher shrugs, teacher nods, or any type of only non-verbal response. We are looking for verbal responses only.</td>
</tr>
<tr>
<td>“Good work” or “Job well done.”</td>
<td></td>
</tr>
<tr>
<td>“You got it!” or “I appreciate that.” (&quot;it&quot; or “that” refers to content).</td>
<td></td>
</tr>
</tbody>
</table>

**Specific Affirmation - Background:** Implementing norms and routines for academic discourse and work. The teacher is making explicit, commenting on, reviewing or reinforcing, or teaching students specific norms and routines for academic discourse. The teacher might praise or reinforce the use of an established norm or routine (METEX -TW07). Providing oral and written feedback to students on their work (High-leverage practice #16).