

# **Bill & Melinda Gates Foundation Final Report**

**University of Central Florida Foundation  
College of Education and Human Performance and  
College of Electrical Engineering & Computer Science:**

**UCF TLE TeachLive™**



**Report prepared by  
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**August 2016**

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UCF TLE TeachLivE™**

This report is a summary of the overall progress of the UCF TLE TeachLivE™ (TLE) project at the University of Central Florida (UCF). This report is supplemented with links to annual reports provided to the Bill & Melinda Gates Foundation each year of the funded project. Also, attached to this report is a summary of the work completed with our interactor protocol (see Appendix A), avatar profiles (see Appendix B), along with the awards, publications, and presentations (see Appendix C) aligned with this three-year project.

The UCF TLE team is very appreciative of the funding from the Foundation. The funding has allowed our team to accomplish all proposed outcomes and, in so many ways, the outcomes have exceeded many of our initial milestones. We also are appreciative for the continuing partnerships that have emerged due to the ongoing financial support and connections of our project officers over the course of the grant. We received wonderful stewardship from Andrea Foggy-Paxton, Amy Slamp, and Kai Kung. It is impossible to measure the huge contribution that the Foundation has provided in connecting us with so many thought and project partners, even to the level of connecting us with New Schools Venture Fund that provided additional funding and enticed Mark Atkinson who is now the CEO and licensee of the TLE TeachLivE™ software. This successful commercialization of TLE emerged from the Bill & Melinda Gates Foundation's dedicated and passionate project officers who connected us with the Mathematics Design Collaborative (MDC), Literacy Design Collaborative (LDC), Measures of Effective Teaching (MET) Project, New Schools Venture Fund, Joan Ganz Cooney Center, Digital Promise, Broad Foundation, Educational Testing Services, American Institute of Research, and the Schusterman Foundation. These partnerships have contributed in so many ways to our project that have enhanced our overall thinking, our research design in teacher preparation, and the commercialization outcomes of this project.

The pinnacle outcome of this funding is the creation of a new platform of technology being used at the time of commercialization across over 80 colleges of education and a smaller number of school districts to impact teacher preparation and professional development. The funding also fostered emerging uses in a wide array of other human training and preparation fields. Interest in the use of TLE has occurred around the globe with actual use taking place in the UAE and Malaysia. Daily we continue to develop new collaborative and research partnerships with organizations in countries such as Switzerland, Italy, Mexico, and Australia that are seeking to engage with us on an array of projects. The use of TLE has expanded beyond the deep roots in teacher preparation into hospitality, school leadership training, foundation development officer preparation, student leadership training, school counselors, supporting students with autism in developing higher communication skills, students reinforcing reading skills, and supporting college students as they prepare for the world of work. We have evolving projects focused on student use of the simulator to impact learning and a strong interest in the field of medicine for physician training and for use in sex education, including some emerging plans for a pilot project

in the use of AIDs prevention in Botswana, Africa. Finally, we have a project that was funded by the National Science Foundation to help beginning college students develop protective strategies for self and others, and another as yet unfunded project designed to help law enforcement officers improve their de-escalation skills in crisis situations.

We have provided a summary of our successes related to each of the outcomes proposed in the initial grant proposal followed by statements noting how we have met or exceeded each outcome and milestone. We then provide a summary of activities and accomplishments, as well as any remaining issues or challenges that have emerged related to each outcome.

**Outcome 1: Develop a plan to incorporate College Ready Work instructional strategies and effective teaching practices as outlined in the MET study into TLE TeachLivE™ research cadres.**

The TLE team at UCF met this outcome and all milestones. In many cases we feel we have exceeded the anticipated level we thought we could accomplish at the initial time of funding. The overall outcome of this work can be found in three years of annual research reports provided to the Foundation. We also have provided the link to each of these report. A discussion of each of the milestones related to this outcome is provided in these reports along with detailed narrative provided regarding the milestones proposed.

Year 1: Straub, C., Dieker, L., Hynes, M., & Hughes, C. (2014). [Using virtual rehearsal in TLE TeachLivE™ mixed reality classroom simulator to determine the effects on the performance of mathematics teachers](#). *2014 TeachLivE National Research Project: Year 1 Findings*. University of Central Florida: Orlando, FL.

Year 2: Straub, C., Dieker, L., Hynes, M., & Hughes, C. (2015). [Using virtual rehearsal in TLE TeachLivE™ mixed reality classroom simulator to determine the effects on the performance of science teachers: A Follow-up Study \(Year 2\)](#). *2015 TeachLivE National Research Project: Year 2 Findings*. University of Central Florida: Orlando, FL.

Year 3: Hynes, M., Dieker, L., Hughes, C., Straub, C., Bousfield, T., & Taylor, M. (2016). [Efficacy and evolution of TLE TeachLivE™ mixed reality classroom simulator and associated scenarios for commercialization and to meet the needs of school administrators and of teachers in inclusive classrooms \(Year 3\)](#). *TLE TeachLivE 2016 TeachLivE National Research Project: Year 3 Findings*. University of Central Florida: Orlando, FL.

In year 1, the team did a deep dive into both the MET study outcomes and how the team could most effectively design a national study to determine the outcome of effective teaching practices in simulation. The year 1 study involved collaboration with the Mathematics Design Collaborative that allowed the team to create a study framed in middle school mathematics with the TLE avatars. This work allowed UCF to collaborate with partnership universities across the country to increase the number of users of TLE, while building a stronger research cadre in teacher education, middle school, and mathematics. In year 2 this study was expanded in collaboration with the LDC team and focused on high school biology using the new TLE avatars created by the Foundation funding.

In year 3 the team had found significant positive changes in teacher practices in years 1 and 2, so the team moved to an array of exploratory studies.

*1a Identify priority supporting instructional tools and area of targeted teacher effectiveness from the MET study to be included in the RFP.*

Each of the first two years of the study, an RFP was created for universities across the country to compete to be part of a national study on the use of TLE. Year 1 focused on partnerships across the country working with the already existing middle school avatars using the MDC lessons in math to work on targeted behaviors. The outcome of this year's work was a model that could be replicated in year 2 along with a validated tool to observe transference of skills from the TLE simulator to classroom practice. This study in year 1 allowed us to add new partnerships in the use of TLE.

During year 2, the first year study was replicated with the new avatars that were created through funding from the Bill & Melinda Gates Foundation funding. The team created a classroom of five high school avatars using a new coding structure and in a new format that allowed for more flexibility, affording the team the ability to create a study in year 2 in a high school setting. The year 2 study allowed the team to conduct a study that replicated the findings from year 1 with positive changes in teacher practice using our already validated tool from year 1 and in student learning using concept maps.

The year 2 study found similar patterns to year 1 on the teacher behavior changing in four 10-minute sessions and those changes transferred back into practice. The TLE team with support from program officers Slamp and Kung decided to explore new avenues for TLE in year 3. We also knew at the end of year 2 that we were on the path of commercialization earlier than planned as the number of users of TLE across the country and emerging use in the UAE were at a level of volume greater than the UCF team could serve. We also saw this as an appropriate time to commercialize as the existing numbers of satisfied clients provided a great foundation for the start of a new business.

Year 3 saw the development of a wide array of studies across (1) teacher preparation, (2) student learning, and (3) preparation of other education professionals (e.g., administrators, counselors, related service providers, psychologists). The team used this final year to formalize the UCF partnership for commercialization of our work with Mark Atkinson and the new company, Mursion. We also began the process of moving existing partners to the business as well as conducting national research on an array of areas of interests to the TLE team to expand the use of the simulator.

Our work has expanded at the end of this grant to the areas of preparing teachers for gifted education (Javits grant funded) and a Race to the Top grant that allowed 150 STEM teachers to use TLE for management preparation for the classroom and practice conducting parent-teacher conferences as they entered as new teachers. We just recently became a research partner with Johns Hopkins University through the Institute of Education Sciences in the area of behavior management.

Over the course of this grant we were awarded bridge funding from the New Schools Venture Fund to overcome some gaps in our work in years 1 and 2. This funding focused on supporting our work in the further development of the avatars and training of interactors for scaling TLE up to a business model. We also have partnered with Digital Promise and received a small grant from the Schuesterman Foundation to support our creation of micro-credentials to be used in TLE. We have been very fortunate to also have three years of funding from the Bert W. Martin Foundation for the creation of avatars with disabilities (autism and intellectual disabilities). These avatars were integrated into the design of our new high school environment that was funded and developed from this Foundation Grant. The most recent gift from the Bert W. Martin Foundation is being used to create avatars at the elementary level that will be integrated with the avatars from the Javits grant focused on students who are gifted. We also have partnered with the Goldie Hawn Foundation for work in creating curriculum focused on students understanding the way their brains work. Additionally, without funding, we have repurposed three of our existing avatars to be second language learners in collaboration with a faculty member in the College of Education, Joyce Nutta, and our team of talented interactors. From these examples our research in TLE has had both depth and breadth in the use of the TLE simulator. Our current and ongoing challenge is to continue developing our work now that there has been a successful transition to commercialization of TLE. More discussions about this and other challenges are provided in the discussion regarding commercialization in outcome 3.

*1b Expand as a PD model for districts across the country to impact practicing teachers aligned with the MET study*

The UCF team used MET study model along with incorporating work from the Marzano and Danielson evaluation tools to create of our own tool, the Teacher Practice Observation Tool (TPOT), that was used with our university partners in years 1 and 2 of this grant for our research. At this time, we at UCF have several school districts using this tool and this work is expanding as part of the successful partnership and commercialization that has occurred by Mursion. We at UCF continue to work with universities, schools, and districts on research projects across the country. All of the PD we have conducted and the alignment of our work with the MET study has been made publically available on the TeachLivE website. <http://teachlive.org>

The use of TLE has been institutionalized in our elementary program and our leadership program at UCF and frequently is used in our other programs for targeted skills. The ways of use of TLE at UCF and in all of our projects is readily shared with other districts and universities. The materials used in our research projects over the three years have been used by other local, state, and national grant projects to assist in the design of TLE studies and used in teacher preparation at both the inservice and preservice level.

**Outcome 2: Develop and Manage TLE TeachLivE™ research cadres with a focus on increasing teacher effectiveness and student learning.**

We have met the outcomes during the funded grant, yet, due to commercialization efforts, new challenges have emerged for the UCF TeachLivE team. The successes and continued challenges related to each milestone are summarized below.

## *2a Develop RFP for existing and future research partners*

The studies conducted over the three years of the project all involved an RFP process for participation and funding of the research study within the university and across partnership school districts. An unexpected finding in year 1 was that many of our university partners did not have the level of partnership required to get the number of teachers we needed for our overall research goals. As a result, we found we had to count on our strong partnerships with Central Florida school districts to help us complete the study. In year 2 we anticipated this problem and only offered financial support per teacher delivered. Again, we found that some locations struggled with a true partnership with local districts and in year 2 we also had a huge issue with northern partners encountering unprecedented snow storms. Overall, we were able to once again tap into our deep relationships with Central Florida school districts to ensure we met the overall study requirements. In year 3 our studies were small but we counted on strong and targeted partnerships from lessons learned in years 1 and 2.

Overall, we were very successful in confronting numerous challenges with conducting large national studies, but we have new unforeseen challenges that emerged this last year due to the commercialization of TLE through Mursion. Our challenges have been two-fold in the area of research partnerships. First, many of our interactors moved to work for Mursion when TLE was commercialized causing a limitation in partnering with research partners until projects were funded. Second, the licensing agreement with Mursion allows UCF to continue to use TLE for any and all research activities, which is still occurring. Our bandwidth, however, to serve the number of partnerships that are emerging with many of our core team members (research and technology support) now working for Mursion has created new challenges in trying to serve so many partners. At least weekly we are contacted with new research areas of interest (e.g., police force de-escalation, sex education, behavior, gifted education, second language learners, student learning, counseling, bullying, behavior management, working with our avatars who have disabilities). The leadership at Mursion communicates with us regularly, and, yet, their lack of bandwidth for an array of research projects often requires our UCF team to provide services to universities and colleagues who partnered with us in the past. We see this as an appropriate role of our team; however, with numerous international partners emerging along with new avenues of use, our team is beginning to question our capacity. This challenge is one we talk about almost daily. Mursion has the ability to do research projects too. For example, Mursion has been conducting a large scale study with ETS. As a new company serving many customers, including use in new areas, such as hospitality management, Mursion has stretched its capacity from our observation. So, we have found that, often when a large-scale research opportunity has emerged, Mursion's team has sent that work to us. These "opportunities" require a constant need to hire and train short-term and long-term interactors in new areas of development. This means for each project we have to create clearly aligned research agendas with faculty members at UCF and across the globe, while ensuring the infrastructure of TLE is continually updated with changes in emerging technology or changes in past infrastructure tools (e.g., updates of Skype and Unity) while providing the technology support for all projects we undertake. We had expected that, with commercialization, we would move out of many of these business tasks but, due to the boutique nature of many projects in research, we seem to be back into having to support a large team but operate with much less infrastructure. This creates more of a disjointed model of collaboration for

our team. We continue to explore ideas to address this sporadic nature of funded projects, seeking a better outcome for all.

One potential solution to this problem could be the development of a simulation research center in education at UCF, but this option has not been viable at this time due to lack of funding. This challenge is one for which our team continues to look for solutions, but we are excited that the commercialization of TLE has occurred and look forward to facing these new challenges. Our team has been successful in the past with persistence in finding the most effective outcome for all involved, and we move forward with this same positive assumption.

## *2b Establish research cadres*

This milestone occurred very naturally through our two years of large-scale projects, and yet, the number of uses of the TLE platform and of Mursion's capabilities seems to morph and expand daily. The team's ability to harness all research beyond what has already occurred is a new challenge, and one we are looking for ways to address. We also are very interested in expanding our direct work in teacher preparation to two new areas that we think are critical next steps. We are very interested in how we might use the work of experts in neurophysiological data to see if we can detect in the simulator effective nonverbal communication teaching skills. The next step is to verify how expert teachers use nonverbal communication skills that can be detected in the simulator. We think this is the most immediate need in adding more feedback to the simulator that assists all teachers in being more effective. The second area we think is ripe for future research is associated with our work with student learning using the simulation for content knowledge and skills, college readiness, and career readiness skills. We think that, for students of poverty and students with disabilities, having especially seen some promising results for students with autism, the potential of this TLE work could be transformational.

## *2c Receive and analyze reports from each cadre*

Beyond the cadres aligned with each research report and TeachLivE conference created over the three years of the project, we have new and expanding cadres occurring at a pace that is difficult for us to keep up with at this time. We also have had four years of successful TeachLivE conferences with over 100 attendees each year as a format to share work across cadres, disciplines, and even expansion of new areas of which we are sometimes unaware prior to the conference. We have analyzed the findings from each study and each conference by creating an annual conference proceeding. These proceedings can be found at <http://teachlive.org>

We currently are in discussions with American Institutes for Research (AIR) to consider a national implementation study to determine how TLE is being used across university partners as we continue to see the use of the technology expanding so quickly to over 90 partnerships. We continue to have new partners emerge at a rapid pace, but an institutionalized center at UCF to handle these partnerships has not yet emerged as we had hoped it would.

### **Outcome 3: Establish TLE TeachLivE™ as a self-sustaining collaborative or business model and expand the TLE TeachLivE™ partners from 10-30.**

This outcome was met in the first 12 months of the grant funding and our team excitedly exceeded this outcome to having over 80 partners within 24 months when Mursion began to take over as the licensing agent and commercialization partner of TLE. We have provided a summary of each of the milestones related to this outcome.

One milestone not listed when this project was initially funded was that of patenting the TLE system. Although the patent application was filed early in the project, the final approval occurred only very recently, with a patent being awarded to UCF as of July 2016. The patent information is as follows.

Charles E. Hughes, Lisa A. Dieker, Arjun Nagendran, & Michael C. Hynes, “Semi-Automated Digital Puppetry Control,” US Patent No. 9,381,426 B1. Awarded July 5, 2016; Filed March 17, 2014; Provisional Application March 15, 2013. Assigned to University of Central Florida Research Foundation, Inc.

#### *3a Add additional TLE TeachLivE™ partners*

This milestone is one that has not ended with funding but continues to expand at a rapid pace. Mursion has just reached its 2<sup>nd</sup> year of success and the UCF Office of Research and Commercialization has reached an agreement with Mursion that has allowed UCF to continue to do research and expand our work in the system (e.g., using the Vive) to continue to build synergy around use of the system in both existing and new venue, but without a clear funding stream. We have turned over all traditional partners using the TLE infrastructure to Mursion and retained partners in areas of working with English Learners, gifted education, disabilities, high school and elementary teacher preparation, and an array of research partnerships.

#### *3b Increase TLE TeachLivE™ Infrastructure*

The infrastructure that occurred in this grant was greatly accelerated by an ongoing stream of funding and in year 1 the funding allowed our team to develop a new infrastructure for how we created avatars that was more streamlined, interchangeable and evolvable than our first generation of avatars. The other infrastructure that was created was the overall training and procedures for creating what is a new profession of interactive performers. This process is outlined in the interactor report attached in Appendix A. Third, this funding allowed us to conduct three large scale studies and to have three TLE conferences. The infrastructure for the interactors and business and development of the avatars has been instrumental in the launching of Mursion. Yet, the research component of our infrastructure and even our prepared interactors have moved to Mursion causing us to have limited bandwidth for many new partnerships. Specifically, the funding over the three years allowed the UCF team to have a strong model, but many of those team members are now with Mursion including interactors and technology/research team member. The more sporadic nature of our grant work and use at UCF has created new challenges in retaining a core team to address continued emerging partnerships and being more reactive rather than proactive to our own infrastructure for partnerships.

### *3c Development of additional technological components*

This milestone has been met over and over again, but the challenge is that the technology we use or for which we want to be early adopters changes almost daily. We are continually exploring new ways to integrate technology, add features to the simulator, and reduce the cost of equipment for users of the simulator. We have created a feedback system integrated with TLE, called ReflectLivE, that continues to evolve in features and usability. An early version of this tool was used in our research. It is intended that ReflectLivE will give teachers automated and human-entered data. We have had challenges throughout the project with ReflectLivE as we moved from our previous Ogre platform to Unity, and from purely human input to semi- and fully-automated annotation of events. As always, new models emerged with technology advances along with new challenges to be conquered.

Our biggest and ongoing technology challenge is focused on the use of the Hydra to puppeteer the TLE system. The Hydra, which is somewhat fragile when used extensively, is no longer manufactured and the introduction of its next generation replacement has been delayed numerous times. The use of a new device to puppeteer our avatar has been critical as we have pushed our work out for use on laptops and more mobile platforms. We continue to look for ways to address this challenge.

Our team's entrepreneurial spirit, though, has served us well for the range of work. We are doing work that is more experimental whereas Mursion is providing clients standardized services. We continue to explore ways to make TLE more and more automated and to involve more advanced technologies (e.g., Vive, Hololens, Oculus, automated feedback in the simulator, using the Kinect for teacher feedback, and more immersive CAVE types of environments). We also continue to be interested in the range of immersive feedback systems to be paired with TLE and how we might use more neurophysiological and haptic tools in the environment. We started a small study to look at stress and workload indicators such as perspiration, blood pressure, and pulse rates with limited success due to technical issues. Fortunately, these have been largely resolved with the advent of more reliable and accurate sensors such as found in the Empatica E4. We continue to look into ways to expand this area of using external and body-worn sensors to understand a teacher's mind and body, both in the simulator and in real world contexts, to better prepare and inform pre- and in-service teachers.

The Kinect has provided some interesting data and one of the doctoral students in Computer Science has won several awards for her work using the simulator to help teachers understand how nonverbal communication related to their body poses can influence their teaching effectiveness. We are very interested in how we might further explore the nonverbal communication, brain waves, and neurophysiological state of a teacher's body both in the simulator and in the classroom much like we did in year 1 and 2 of our Gates Foundation study.

Overall, our team is both appreciative and equally excited about the outcomes of work with this grant funding. We feel we were very frugal in our approach while zealous in our impact, ensuring we conducted the strongest research possible, creating a new model that is now commercialized in teacher education, and ending this three-year project with what we consider TLE to be -- a great

success and contribution in teacher education and emerging in many other fields. We feel at this time we have more questions than answers, but we have a high level of confidence that the tool we have created is a disruptor in the teacher preparation space and that our work will continue for decades to evolve and more effectively prepare teachers. From what we are observing, humans in general will find a simulator a safe environment where learning can be compressed, but the outcome is most importantly a change in behavior. We dream of a future where parents, teachers, adolescents, leaders, politicians, and humans in general can avoid many costly human errors using simulation, much like aviation, medicine, and the military have done for decades. We thank you for the opportunity to be a part of the forward movement of this change in human simulation that involves digital puppetry, and we look forward to ongoing and future partnerships.

# *Appendix A*

Interactor Report

# *Interactor Report*

Prepared by Dr. Kate Ingraham

## *Introduction*

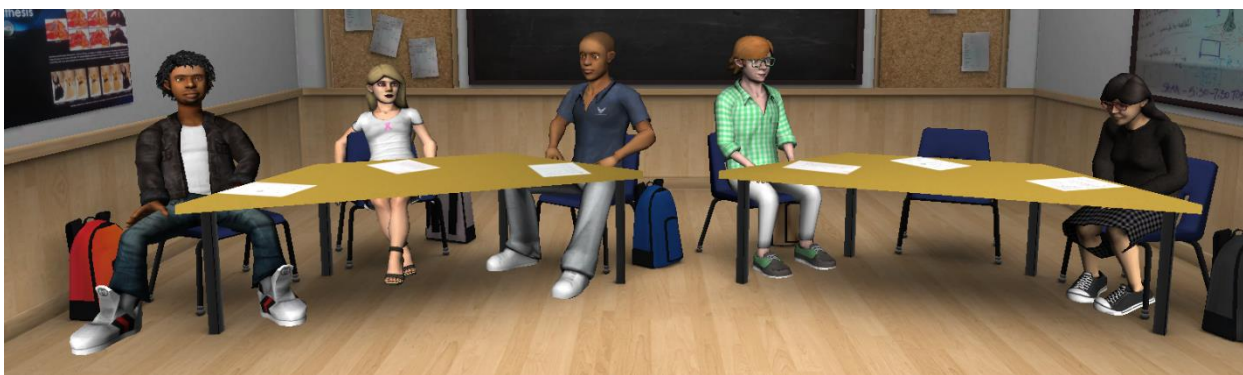
Developing an interactive virtual learning environment is an interdisciplinary effort that requires the contributions of a team of educators, computer scientists, subject matter experts, and artists. While there are many potential methods of developing an interactive product, we chose to follow a rapid prototyping model, which allows for early opportunities to incorporate feedback from subject matter experts. Expanding on the existing TeachLivE middle school classroom, we faced the challenges of creating a more modern classroom design as well as extending performance capacities through a greater range of new avatar characters. This section describes the developmental process that the TeachLivE research team and the Synthetic Reality Lab (SREAL) went through to develop the TeachLivE high school classroom and prepare for commercialization of the TeachLivE system.

## *Creating a More Modern Classroom Environment*

In the TeachLivE middle school classroom, students are seated in two staggered rows in a static setup reminiscent of industrial era educational practices. Through working with our middle school classroom, we collected feedback from many educators expressing the desire to get the kids out of rows and into more collaborative classroom arrangements. We reviewed literature related to classroom designs and looked for classroom seating arrangements that would suggest flexibility and the potential for multiple working arrangements (Bautista & Borges, 2013). Thus, when it came time to design the environment for the high school classroom, we decided to build a collaborative table setup. In visiting many classrooms and weighing the options of laboratory tables and other reconfigurable classroom seating options, trapezoidal tables were chosen in order to suggest a reconfigurable space and facilitate tracked teacher movement throughout the classroom environment of the simulator.



Figure 1 - Middle School Classroom

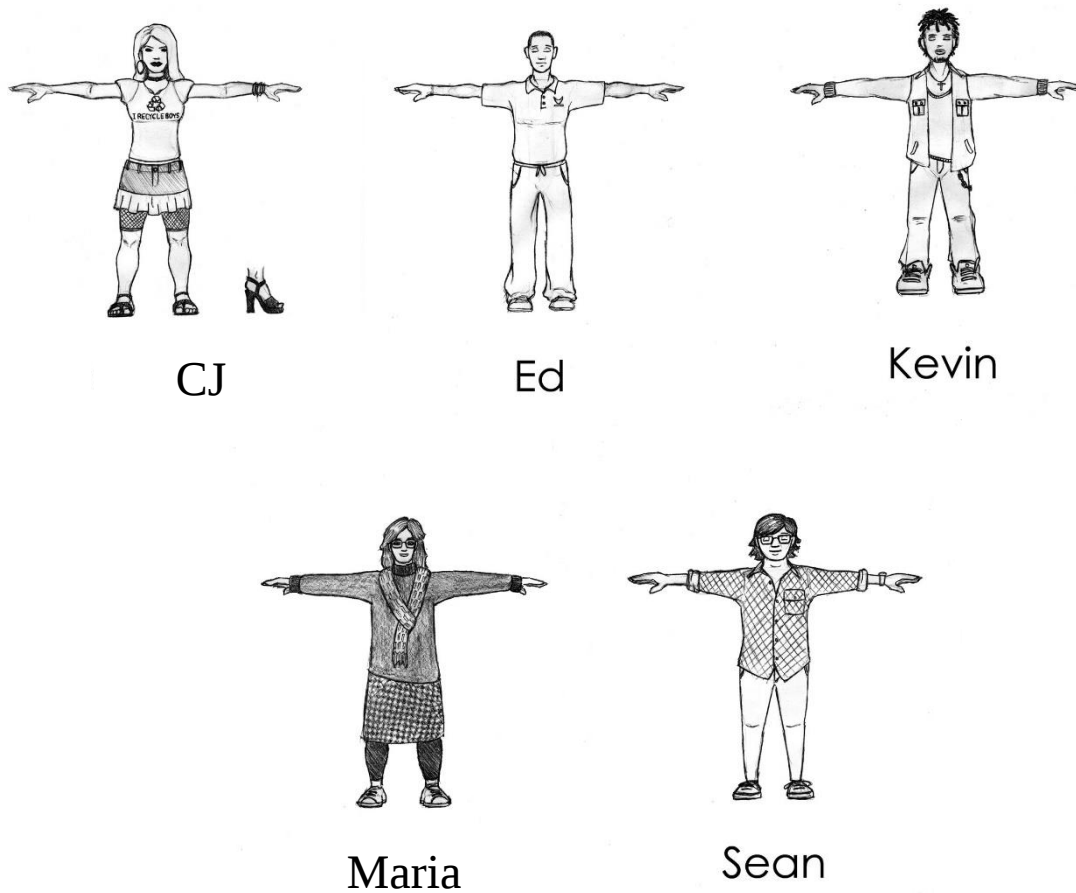


**Figure 2- High School Classroom**

One challenge that we faced in moving to the tables is adjusting body pose orientation for each individual student avatar. Unlike the original middle school classroom where students were oriented towards the front of the classroom, the shape of the trapezoidal tables requires students to have varying orientations in relation to the front of the classroom based on their seats. Adjusting orientations for Kevin and Maria were particularly challenging as they sit at the end of the tables in the leftmost and rightmost extremes of the room, respectively. These positions combined with table shape made it so that they are essentially in profile for teachers standing at the front of the room. To add further complexity, when teachers approached Kevin or Maria, profile views of the avatar became less authentic as students tend to adjust orientation to face a teacher as he or she approaches. Thus, to allow the same range of motion for our virtual avatars, additional poses oriented to the front of the classroom as well as in profile needed to be added to the characters' standard pose sets.

### *Creating Older Students*

The next challenge in developing the high school classroom was to transform our middle school student avatars into more mature high school students. Artistically, this was accomplished by a full modeling development cycle, beginning with concept art that was modified and refined to reflect the previous middle school students, while also increasing the level of realism in the avatars.



**Figure 3 - Early Concept Art for High School Avatars**

In addition to avatar models, the performance profiles for the student avatars needed to be transformed to reflect high school students. Since the original middle school student avatar profiles were inspired by real students, we returned to the histories of those real students for inspiration in building the profiles of the high school students as well. Academic profiles were updated to reflect content material and standards that would be grade-appropriate for high school students. Personality profiles were also adjusted to reflect increased maturity.

For the original middle school personality profiles, we used the work of William Long (2011) on adolescent development to define personality traits for our student avatars with the goal of providing a representative sample. Long defines key coordinates of personality along the spectrum

of aggressiveness versus passiveness in combination with dependent and independent motivational focus.

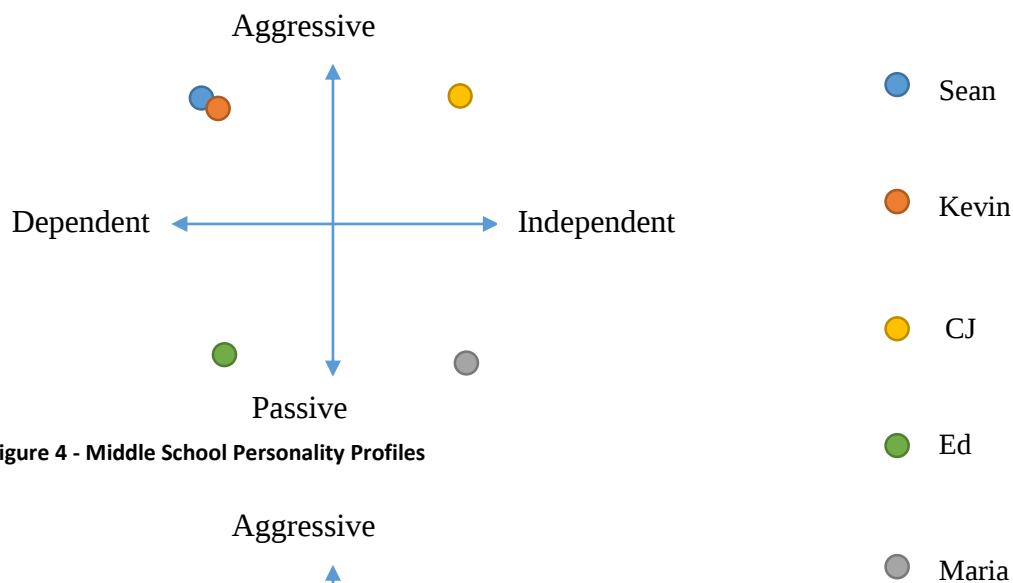


Figure 4 - Middle School Personality Profiles

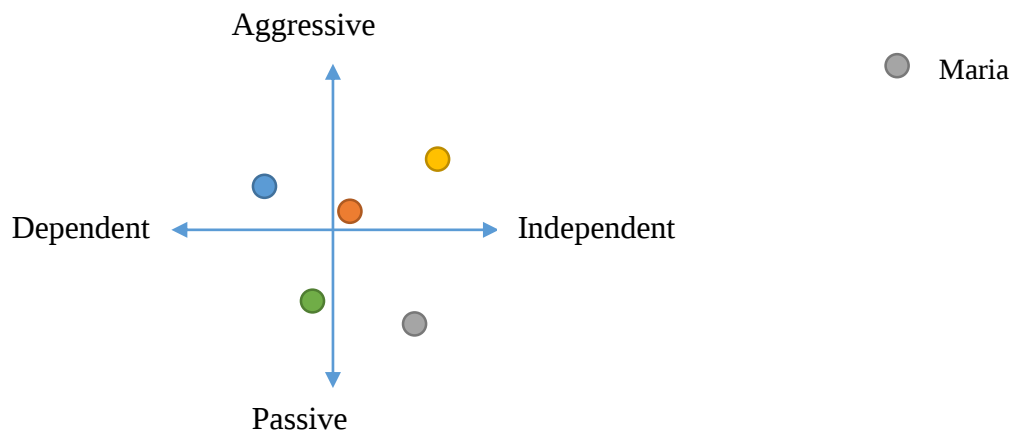


Figure 5 - High School Personality Profiles

Reflecting Long's theory that personality types are most pure in early adolescence and blend and soften as individuals mature (2011), we adjusted the personality profiles of the high school student avatars to reflect that maturing process. Linked to personality profiles, student preferences in activities, books, movies, music, etc. were also updated to reflect age-appropriate interests for high school students. See Appendix B for executive summary profiles for the high school students.

### *Voice Modification*

The third challenge that we faced in developing the high school student avatars was to create realistic and differentiated vocal performances for each avatar. In the middle school classroom, all five student avatar voices were modified in-voice by interactors. The benefit of this method was that it provided voice characteristics that sounded human and could easily be differentiated between avatars. The costs of this approach were that a) it placed a high-level vocal skill

requirement on recruiting interactors that limited the pool of potential interactors and b) it placed a gender limitation on interactors, as male interactors were unable to reach the high vocal registers necessary for a convincing female middle school student voice. Developing a mixed gender high school classroom forced us to confront the same issue. Our team of female interactors were not able to reach the low vocal registers necessary for a convincing male high school student voice.

To address this issue, we implemented a voice modulation software called MorphVox (“Screaming Bee: MorphVOX Pro,” 2016). This software allows the interactor to digitally pitch shift vocal input and send the modified audio through Skype. The software also allows for the creation of multiple shifting profiles. Thus, once we added a piece of code to the TeachLivE software that would manage the selection of appropriate voice profiles, the interactors were able to shift between voice modulation settings automatically when switching characters. However, introducing the voice modulation software did present additional challenges.

First, we found that using the voice modulation software increased the data bandwidth that we were sending from the server to client computers. In instances where we were running the TeachLivE simulation on internet connections with low bandwidth or on wireless internet connections, we experienced more frequent dropping of calls on Skype as well as video freezing and digital distortion of the interactor’s voice. This remains an area of active development with both the commercialization team at Mursion and the research team at UCF. Next, we found that the modified voices did not sound the same on the server side as they did on client sides. Thus, in preparing for a session an interactor may test modified voice profiles and find that they sound authentic and natural, but when they are heard on the client end, they may sound unnaturally shifted or distorted. Thus, when using the voice modulation software, we found it necessary to add an additional testing protocol with clients to test the sound of each student avatar voice and make adjustments in the voice modulation software as needed for each individual session. This protocol did slightly increase our setup time for the simulation as well as our training time for new interactors as now they must learn how to modify voice profiles in the software. Finally, we found that, while the voice modulation software was suitable for pitch shifting, it was unable to add other vocal characteristics in a manner that sounded natural. Thus, interactors are still required to modify their voices for every character to make them distinct even when using the voice modulation software.

Ultimately, the voice modulation software was successful in providing the critical pitch shifting function that we required for the high school classroom. Additionally, since the software was effective for both women shifting down into male vocal ranges and men shifting up into female vocal ranges, we were able to hire additional male interactors thus increasing the diversity of our team and the potential pool of future recruits. The code that was developed to implement the voice modulation in the high school classroom was also applied to the existing middle school classroom so that male interactors on the team could perform sessions for either classroom.

### *Improving Session Preparation Procedures*

To support our goal of developing a high school classroom, we also wanted to expand the range and flexibility of the types of sessions that we could facilitate in the TeachLivE environment. One challenge with the high school classroom was the incorporation of higher level, more complex

lesson content. Thus, to support higher level sessions, the interactor team created a digital resource board for quickly researching content areas and gleaning appropriate academic error patterns. Once collected, error patterns were shared with content area experts on the TeachLivE team or at partner sites in order to collect critical feedback. Error patterns were modified according to expert feedback and then assigned to student avatars. Vetted error patterns were then shared on an internal digital resource board for reuse for future sessions. As subject areas for sessions expand, we are looking to expand the digital resource board into a more formal database of research based error patterns that can be easily incorporated into TeachLivE sessions.

## *Transitioning to New Behavior Recording Methods*

In the middle school classroom, all avatar behavior was built around a pose-based system. Interactors would determine a set of ten to twelve poses for each student avatar. Next, the system animator would add three key frames of animation to each pose. Once the poses were completed, interactors used an integrated recording software to record and save “puppeteered” sequences. These sequences became the “triggerable” behaviors in the middle school classroom. The benefits of the pose recording system are that: a) no specialized equipment was required to record the behavior sequences; b) recorded sequences could be very quickly implemented in the system; and c) recorded sequences could be easily replaced in a matter of minutes. The major disadvantage of the pose-based recording system was that all recorded sequences were limited to motion found within the existing pose sets. This limitation meant that complex movement such as walking around the room or leaving desks was impossible.

Thus, in order to support more complex movement and recorded behaviors for the avatars, we changed our method of creating the recorded behavior sequences. We eliminated the pose puppeteering recording system and instead used motion capture recording techniques to create pre-recorded behaviors for the system. In this process, interactors would create video references of each desired recorded behavior for each student avatar. Next, interactors would don a motion capture suit and the system animator would record each behavior in sequence. Then, the system animator would clean the motion capture data and apply it to a student avatar model, adjusting the animation where necessary to improve the look of the finished animation. The benefit of this method is that we were no longer limited to actions that could be contained within animated pose sets. The disadvantages of this method are that a) it requires a motion capture space, cameras, suits, software, and expertise; b) the process takes significantly longer to implement recorded sequences in the system; and c) once recorded and animated, the sequence cannot be changed without restarting the entire motion capture process.

Additionally, in working through the motion capture process, our team learned and developed several protocols to make the motion capture behavior recording process more efficient and effective in the future. The following subsections briefly outline the best practices that we discovered.

### *Capture Lists and File Naming Protocols*

Documenting and updating lists of which behaviors were needed, had been captured, and still need to be captured is critical to making sure that nothing is missed during the recording window. A file

naming protocol should also be included in this list so that recorded motion capture files can easily be matched with the list and related reference recordings. We mistakenly did not include a file-naming protocol as a part of the list the first time through this process, which led to additional work matching recorded files to the capture list. Including the naming protocol in advance would eliminate that extra work.

### *Reference Video*

We found that creating reference videos for each behavior in advance of the motion capture recording was critical for two major reasons. First, recording in advance allowed the interactors to rehearse, review, and revise the behavior design without taking up valuable motion recording time. Since access to a motion capture area can be limited and expensive, rehearsing in advance is much more cost effective.

Second, reference videos were critical for the system animator after the motion capture recording had been completed. When recording motion using reflective markers, one challenge can be managing the data when one or more markers is not visible to the camera. If a marker is occluded, the software system may try to guess where that marker is and sometimes it guesses wrong, which creates some very data that implies undesirable and even unattainable human movements. Having a reference video allows the animator to see what the finished behavior should look like and thus clean the motion capture data with that end in mind.

### *Process Communication and Behavior Length*

One area where our team failed to communicate effectively was in the process of recording, cleaning, and editing the motion capture data. From the interactor team, reference behaviors that were recorded were sometimes quite long. Interactors did not initially understand the length of time that would be required to clean and animate the data for the lengthy recordings. Thus, on recording day, interactors were asked to shorten behaviors into the smallest communicative unit to limit the time and effort for cleaning and animation. Without such limitation, recording the set of behaviors for five student avatars would have been unmanageable, given our development timeline. However, shortening the recordings left us with a significant problem -- when the finished animations were loaded into the system, the action played too quickly, looped too distinctly, and failed to provide convincing behavior.

Further collaboration with the programming team for TeachLivE led us to introduce what we called “padding loops” into the motion capture recorded behavior. The system animator created short neutral behavior sequences for each student avatar from clips of recorded motion. Next, the recorded behaviors were slowed and spaced by adding the neutral padding loops before and/or after the critical behavior loop. Adding the padding loops prevented the instant and continuous looping of behavior, but did introduce latency in some behaviors which required interactors to adjust puppeteering techniques to compensate for delays in the onset and extinction of triggered behaviors. While this makes the system slightly more complex to operate, it was critical to create more believable recorded behaviors. For future motion capture recording, designing behaviors with the concept of critical loops and padding loops in mind should make the process much more efficient and result in smoother, more believable finished animations.

## *Preparing for Commercialization*

In preparation for the commercialization process, we took a critical look at how we could make interactor processes more effective and efficient. In examining the existing interactor team, we felt that we needed to make the following modifications to our practices in order to support the use of TeachLivE on a commercial scale:

1. Decrease the length of training time for new interactors.
2. Improve the standardization of interactor performance across sessions.
3. Improve the communication between interactors so that multiple interactors could work with the same client without losing the modifications and client preferences found in each session.
4. Create a process to monitor and maintain quality of performance across a larger team of interactors.

## *Interactor Training Modifications*

The original model for interactor training was an apprenticeship model. New interactors who joined the team would work closely with master interactors observing sessions, learning the performance and digital puppetry skills person-to-person, and then working into sessions under the guidance of a mentor interactor. This method was extremely effective for us with a small team of fewer than six interactors. However, this method is not very efficient in that it generally took two to three months for an interactor to begin to work on sessions on their own. Thus, we needed to look for ways to shorten the process.

To begin, we moved away from an individual apprenticeship model into a small group cohort training model where several new interactors would train together under one master interactor. Increased session volume now supported hiring multiple new interactors at the same time. Furthermore, we moved away from front loading the bulk of the training to providing a shorter intensive training experience and continuing training spread out over a much longer period of time. Essential performance, technology, and digital puppetry skills training were condensed into a 2-week intensive boot camp training period. At the end of two weeks, each new interactor was evaluated. Based on this evaluation, new interactors would be ranked and cleared for scheduling on TeachLivE avatars for which they have demonstrated proficiency. Interactor ranks are cumulative and include skills mastered in previous levels.

**Table 1 - Interactor Scheduling Ranks**

| Interactor Rank                                                                                                                    | Summary Scheduling Description                                                            | When this rank is generally achieved* |
|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|---------------------------------------|
| White belt                                                                                                                         | Cleared for scheduling on single avatar systems.                                          | End of boot camp                      |
| Yellow belt                                                                                                                        | Cleared for scheduling on middle school (Behavior levels 0-3).                            | 1 month                               |
| Orange belt                                                                                                                        | Cleared for scheduling on high school (Behavior levels 0-3).                              | 2-4 months                            |
| Purple belt                                                                                                                        | Cleared for English Language Learner and Inclusive classroom scenario scheduling          | 6 – 8 months                          |
| Blue belt                                                                                                                          | Cleared for high behavior level sessions and highly customized sessions and demos.        | 1 year                                |
| Green belt                                                                                                                         | Cleared for providing technical support for partners and sessions using new technologies. | 18 – 20 months                        |
| Brown belt                                                                                                                         | Cleared for new scenario development with partners.                                       | 2 – 3 years                           |
| Black belt                                                                                                                         | Cleared for new avatar development and interactor training.                               | 3 – 5 years                           |
| * Please note that these are estimated times that vary based on the starting skills and progression of each individual interactor. |                                                                                           |                                       |

While the boot camp starts the process, interactor training is ongoing with required monthly training sessions. Table 1 describes the generalized progression and approximate time it takes to achieve interactor ranks for TeachLivE. Although training a black belt or master interactor still takes a significant amount of time, the vast majority of sessions in TeachLivE can be facilitated by an interactor at blue belt level or lower. Over half of our sessions can be facilitated by a white belt or yellow belt interactor. Transitioning to this new model has allowed us to get new interactors in session faster and scale up the interactor team quickly. Long term continued training is still necessary for developing interactors at the highest skill level; however, the cost of that training is now spread out over a much longer period, which limits financial risk for a commercial endeavor.

### ***“Student Driver” Mode***

Another innovation that we’ve introduced to help speed up the interactor training model is a new feature in the TeachLivE software that allows more than one interactor to control the avatar system at a time. This allows a master interactor to observe a novice interactor in session and take over control of the system when necessary to make sure that the session stays on track. This feature allows novice interactors to build skills in real sessions without the danger of compromising session quality for the client.

### ***The TeachLivE Interactor Handbook***

In addition to changing our training model, we also took on the task of documenting interactor skills and knowledge that had previously been transmitted person-to-person in the apprenticeship model. We wrote the TeachLivE Interactor Handbook, which documents the interactor team’s policies regarding training, performance evaluation, scheduling, session preparation, session procedures, standardized performance profiles for the avatars, and technical digital puppetry

references. We have found that taking the time to document all of these aspects of the interactor work process has helped trainees by providing an easy reference when learning. It has also helped provide a memory aid reference for veteran team members who may not have worked with one of our avatar systems in several weeks. Additionally, the handbook has also helped us standardize performances across interactors by documenting performance profiles for avatars. To ensure that our handbook stays current and relevant, we review the handbook once per semester as a team and revise the materials according to developments in team practice. Considering commercialization, this document also serves as a way to share ongoing developments in avatar performance with commercial entities delivering TeachLivE sessions.

### *Standardization, Communication, and Maintaining Quality*

One of the challenges of commercialization is that a much larger team of interactors will need to work together to deliver a greater volume of sessions. This presents challenges in providing both standardized avatar performance and continuity across client sessions. Previous methods of frequently observing the sessions of fellow interactors and frequent communication between interactors working from the same location is neither cost effective nor sustainable as the interactor team grows larger. Yet, TeachLivE clients will still expect that information shared with an interactor during a session will not be forgotten for the next session with that client. Clients also expect avatars to be the same in every session no matter which interactor is running their session. Thus, it becomes necessary to build a support structure for the sharing of session information between interactors who run a session with a client and fellow team interactors who may run future sessions with the same client, without the benefit of having observed previous sessions. Additionally, greater attention must be paid to standardizing avatar performance.

### *Standardizing Avatar Performance*

The interactor handbook previously mentioned was the first tool implemented for the purpose of standardizing avatar performance. Additionally, in monthly training sessions, time is devoted to recalibrating interactor performance on vocal profiles and standardized levels of behavior for all avatar systems. Beyond the training component, the interactor team has also implemented a practice of periodically spot checking sessions by having a master interactor observe a portion of a session and provide notes and feedback to the interactor of where the interactor is doing well and what aspects of performance need to be improved in order to align with standardized profiles or improve session quality.

### *Supporting Communication for a Large Interactor Team*

In scheduling, our practice is to attempt to schedule the same interactor for all sessions for a client so that the client and interactor can form a close working relationship and maximize the quality and customization of the TeachLivE sessions for that client. However, with the increasing volume of sessions, this practice is not a sustainable solution; thus, we investigated other means to maintain continuity between sessions with the assumption that a client would work with multiple interactors.

After investigating several potential forums for digital communication between interactors, we settled upon a digital resource board software called Trello (“Trello,” n.d.). After each TeachLivE session, interactors create a card on Trello that documents what happened during the session and

what future interactors who work with this client on this type of session will need to know. The card is filed under a list for the client and color coded with the avatar system used during the session. Before each TeachLivE session, interactors take a few minutes to review previously posted session cards for that client or cards using the avatar system if no previous cards for the client exist. If there are questions or points of confusion, interactors can comment on a session card. The author of the card is notified of comments and can respond. As a whole, the interactor team found Trello to be an intuitive resource to use for this purpose. In fact, Trello was so well liked, that we also replaced our technical issue reporting system with Trello so that interactors could indicate any technical difficulties they experienced during a session on their Trello session card. A member of the technical support team would be flagged on any technical issue report and could follow up directly to address this issue.

### *Maintaining High Session Quality*

One concern that arose when considering the commercialization process was how we would maintain high quality sessions as both the volume of sessions and the size of the interactor team grew. Frequent observation of interactor sessions on that scale would no longer be a viable option. While we kept session observation as a quality maintenance tool, we greatly decreased the frequency of spot checks to one or two sessions per interactor every academic semester. To compensate for the decreased observational data that we would receive from session observation, we implemented a new web-based session feedback survey. The survey is brief, only requiring two to three minutes to complete. After each session, interactors send a link to this survey to the instructors and facilitators using TeachLivE. The survey asks each instructor or facilitator to rate the interactor's performance in terms of preparation, authenticity, appropriateness for session objectives, and overall quality. The survey also asks the instructor or facilitator to rate the TeachLivE software itself and their overall experience. Instructors or facilitators can also write in comments about their session and provide an email address if they would like a TeachLivE team member to follow up with them regarding their session experience.

Survey responses are shared with the interactor for whom the feedback was submitted, and the director of the interactor team. This allows interactors to monitor their own performance and helps the team director identify areas of weakness in performance both for individual interactors and for the team as a whole. Team weakness that are identified become the focus of the next monthly interactor team training session. Individual interactor weaknesses are addressed by the team director through discussion, additional training, and / or other methods of support such as job aid resources (session procedure checklists, summary character sheets located at servers, etc.) as is appropriate for the situation. By this method we hope to improve the overall quality of all sessions over time.

### *Transitioning to Commercialization*

Although we did prepare for the commercialization process, we did encounter several challenges as a team when the time to separate into a commercial entity and a research entity came. From the perspective of the team of interactors that remained with the research side of TeachLivE at the

University of Central Florida, commercialization brought on a paucity of available interactors and a rapid reduction in the capacity to continue research that required the use of TeachLivE.

Mursion, the company that licensed TeachLivE, hired away the vast majority of TeachLivE interactors. Only two interactors who did not work for Mursion in some capacity remained on the research team. The remaining members of the team split their time between Mursion and UCF TeachLivE sessions working both places. However, since Mursion sessions offered a higher hourly rate of compensation than UCF TeachLivE sessions, we quickly found that team members who work in both locations only had availability for UCF if they had no competing Mursion sessions at the same time. This drastically reduced our ability to book TeachLivE sessions. To compensate for the loss in numbers, we held an open audition to add new interactors to the team. We were able to add enough new interactors to cover session needs for the semester, although we did have trouble with new interactors taking positions with Mursion immediately after we had trained them, again decreasing availability for scheduling for UCF research sessions. After conversation with Mursion, we hope to have limited the recruiting of interactors for Mursion from the pool of freshly trained UCF interactors, but in the long term the inability of UCF to match compensation rates for interactor time will likely make this a persistent problem.

To address this issue over the long-term, the UCF TeachLivE team is working on expanding the pool of interactors from which we hire. Traditionally we have hired professional improvisational actors who would be able to operate the TeachLivE avatars with minimal training in basic performance skills. In addition to that pool, the UCF TeachLivE team is also working with existing UCF courses that teach interactive performance to connect to undergraduates who may be interested in avatar performance and in working for UCF TeachLivE. While this approach works with less experienced actors and thus requires a larger investment in basic skills training, our hope is that this will supply a pool of qualified interactors for research sessions and provide a valuable learning experience for young actors who may not have previously considered digital performance as a potential career path.

## *Conclusion*

In summary, over the past year we have expanded TeachLivE not only to include a new classroom of high school student avatars, but also to include the necessary infrastructure and processes to support growth and commercialization. Looking to the future, the UCF TeachLivE interactor team plans to continue to refine our team processes and improve performance quality as we build new avatars and training applications. In addition to these continuing goals, the UCF TeachLivE interactor team is also planning to expand the scope of interactor training to include skills in facilitating research and research design. In the future, we anticipate a higher proportion of TeachLivE sessions conducted from UCF to have a primary research focus as opposed to a training focus. Thus, building additional research skills within the interactor team will allow the interactors to be more knowledgeable team members and take on responsibilities beyond performance in the context of future studies using the TeachLivE system.

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## *Appendix B*

### Executive Summary High School Student Profiles

## Sean McGowan Age 14-18

### Sean's Personality Profile

- Aggressive Dependent
  - Looking for teacher approval
- Over participates
- Grade sensitive



- Storyteller
- Dramatic

### Sean's Academic Profile

- Over achiever, but has to work extremely hard
- Average intellect/learner (A / B student with extra credit)
- Genuine enthusiasm and curiosity
- If he doesn't know what the plan is, he gets stressed (e.g. pop quizzes, etc.)
- Performance anxiety
- Testing anxiety
- Procedural learner

### Sean's Key Facts

- Only child.
- Lives with his mom and dad, who are separating.
- Wants to be an Ecological Engineer, or an Aerospace Engineer.
- Has a dog named Chewie.
- Has a strong interest in musical theater.
- Auditions for school plays and is especially excited about the spring musical.
  - Often receives chorus roles, which, although he would prefer a larger role, he enjoys.

### Sean's Vocal Profile

|                 |                                                                                                                                                                                                                                      |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vocal Qualities | <b>Pitched in the middle (higher than Ed and Kevin; lower than the girls. Lower than his middle school voice).</b><br><b>Nasal resonance, but subtler than in middle school.</b><br><b>His sounds are very forward in the mouth.</b> |
| Energy / Pace   | Fast, but not as fast as middle school, loud, staccato.                                                                                                                                                                              |

## Ed Lewis Age 14 – 18



### Ed's Personality Profile

- Passive Dependent
  - Looking for Teacher approval
- Inattention/sleepy
- Guardian / protector personality type
- Peacemaker
- Strong sense of personal integrity
- Practical thinker

### Ed's Academic Profile

- Diligent and detail-oriented
- Excels at math and concrete logic
- Great memorization skills
- Struggles with literature, abstract thinking, and creative projects

### Ed's Key Facts

- Lives with his mom and dad and three siblings; Ed is the oldest.
- Siblings: little sister Lily (12 yrs); twins Eric and Beth (9 yrs).
- Dad was a military mechanic, did reserves, then retired; now travels, sells, and trains farmers on large farming equipment.
- Mom is a nurse. (See *Adult Avatar: Stacy Adkins-Lewis*.)
- Very structured home life.
- Plays Center on school Basketball team.
- Wants to be a military pilot when he grows up.
- Is dating Monique who is the student class president.
- Will be applying for an Air Force ROTC Scholarship.

### Ed's Vocal Profile

|                 |                                                                                                                           |
|-----------------|---------------------------------------------------------------------------------------------------------------------------|
| Vocal Qualities | <b>Lowest in pitch.</b><br><b>Round, low tones.</b><br><b>Voice resonates in the chest.</b><br><b>Clear articulation.</b> |
| Energy / Pace   | Succinct.                                                                                                                 |

## Maria Gonzalez Age 14 -18



### Maria's Personality Profile

- Passive Independent
- Introverted
- Reserved
- Skeptical

### Maria's Academic Profile

- Highly gifted
- Excels in all subjects
- Favorite subjects are Math and Art
- She has several AP classes on her schedule
  - In her senior year she is planning dual enrollment at the local college

### Maria's Key Facts

- Lives with mom and dad
- Youngest of 3 children
- Oldest brother Alex is in medical school
- Older brother Jorge is in college
- Father is a contractor with an architectural firm
- Mother is an investment broker
- Maria loves art and practices artistic photography
- Maria is an avid reader, reading far above grade level.
  - She enjoys French and Russian novels

### Maria's Vocal Profile

|                 |                                                              |
|-----------------|--------------------------------------------------------------|
| Vocal Qualities | Pitched a lower female voice<br>Breathy tone.                |
| Energy / Pace   | Monosyllabic whenever possible.<br>Comfortable with silence. |

## Cynthia Jean “CJ” Harper Age 14 – 18



### CJ's Personality Profile

- Aggressive Independent
- Tends to dominate peers
- Looking to bait the teacher
- Looking for respect
- Likes to date

### CJ's Academic Profile

- She struggles in most subjects.
- Has excellent oral argument and logic skills.
- Is doing poorly in most subjects and is in danger of dropping out.
  - She is more likely to act out than to admit that she doesn't know something.

### CJ's Key Facts

- Her mother has passed away from Multiple Sclerosis
- Dad is an alcoholic.
- CJ has essentially no supervision at home.
- Has one older brother, Drew, who is a pothead.
- CJ is sexually active and has had multiple sexual partners.

### CJ's Vocal Profile

|                 |                                                               |
|-----------------|---------------------------------------------------------------|
| Vocal Qualities | Pitched the highest<br>Harsh / strident quality.<br>Vocal fry |
| Energy / Pace   | Loud.<br>Grating.<br>Fast paced.                              |

## Kevin Jordan Age 14 – 18



### Kevin's Personality Profile

- Aggressive Dependent
  - Seeking peer approval
  - (especially from CJ)
- Talkative
- Charming
- Not competitive
- Out-of-the-box thinker
- Artistic

### Kevin's Academic Profile

- Low motivation for assigned school work.
- Lack of attention to detail and failure to read directions undermines academic work
- Enjoys assignments where he gets to choose his own topic or medium.
- Would prefer to make a video, stage a sketch, or write a song to a traditional writing or presentation formats.

### Kevin's Key Facts

- Lives with his Grandma who was an activist in the 1960s and lived in New York.
- Doesn't see his dad.
- Close to his mom, but doesn't like her boyfriend.
- Adores his younger half-sister Keisha (age 7) who lives with his mom.
- Plays guitar in a band with friends.

### Kevin's Vocal Profile

| Vocal Qualities                                                                                        | Pitched low, but higher than Ed.<br>Resonates in higher chest range.<br>Wide mouth, resides mid palate.                  |                                                                                                         |
|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Energy / Pace                                                                                          | Relaxed.                                                                                                                 |                                                                                                         |
| <b>African American English (AAE) Syntactic Variation</b><br>(Bowman, Barnett, Johnson, & Reeve, 2006) | • Use of Have <ul style="list-style-type: none"> <li>○ The girl has a big kite</li> </ul>                                | • Substitution "f" for "th" <ul style="list-style-type: none"> <li>○ Bath -&gt; Baf</li> </ul>          |
|                                                                                                        | • Use of Don't <ul style="list-style-type: none"> <li>○ This boy don't like to swim</li> </ul>                           | • Substitution of "v" for "th" <ul style="list-style-type: none"> <li>○ Breathe - &gt; Breav</li> </ul> |
|                                                                                                        | • Deletions of "s" in the third-person present <ul style="list-style-type: none"> <li>○ The girl always sleep</li> </ul> | • Consonant cluster reductions <ul style="list-style-type: none"> <li>○ Gift -&gt; Gif</li> </ul>       |
|                                                                                                        |                                                                                                                          |                                                                                                         |

## *Appendix C*

Awards and Publications Aligned with Contributions from Funding from the Bill &  
Melinda Gates Foundation

## **TeachLivE: Gates Report, Year Three Dissemination Data**

### **Patents Awarded:**

Charles E. Hughes, Lisa A. Dieker, Arjun Nagendran, Michael C. Hynes, “Semi-Automated Digital Puppetry Control,” US Patent No. 9,381,426 B1. Awarded July 5, 2016; Filed March 17, 2014; Provisional Application March 15, 2013. Assigned to University of Central Florida Research Foundation, Inc.

### **Awards:**

2016 Best Paper Award, *IEEE International Conference on Serious Games and Applications for Health*: Hughes, C. E., Epstein, J. A., Hall, T., Ingraham, K. M., & Hughes, D. E. (2016). Enhancing Protective Role-Playing Behaviors through Avatar-Based Scenarios.

2016 2nd Place Award in the Graduate Category by Microsoft Student Research, Barmaki, R. (2016). *ACM Conference on Human-Computer Interaction*: Improving Social Communication Skills Using Kinesics Feedback.

2015 Grand Challenge People’s Choice Award, *International Conference on Multimodal Interaction*: Barmaki, R., & Hughes, C. E. (2015). *Providing Real-time Feedback for Student Teachers in a Virtual Rehearsal Environment*.

2015 *Council for Exceptional Children: Teacher Education Division* Publication Award recipients, announced at the TED 2015 Conference: Dieker, L.A., Rodriguez, J. A., Lignugaris/Kraft, B. Hynes, M. C., & Hughes, C. E. The Potential of Simulated Environments in Teacher Education: Current and Future Possibilities.

2013 National Training and Simulation Association (NTSA). Governor’s Award for Excellence in Modeling and Simulation, highest honor given by the Association.

2013 National Training and Simulation Association (NTSA). Award for outstanding achievement in training.

Dieker invited to NBC Education Nation Summit 2013 based on TeachLivE, one of three hundred leading thinkers in education invited to attend a Summit on Education by NBC President.

2012 National Consortium for Continuous Improvement in Higher Education, Honorable Mention for Leveraging Excellence Award: TeachLivE™.

2012 Innovative Technology of the Year Award: TeachLivE™, American Association of Colleges for Teacher Education (AACTE).

## **Publications:**

### **Under Review:**

Berg, C., Ashmann, S., & Dieker, L., A. (under review) Using TeachLivE Virtual Teaching Avatar Simulation in Science Teacher Preparation. *Journal of Science Teacher Education*.

Taylor, M., Mrstik, S., Dieker, L., Hynes, M., Hughes, C. E., & Straub, C. (under review). 4:1 Positive Praise Microcredential: Strengthening Teachers<sup>1</sup> Classroom Management Skills Using a Virtual Simulator. *British Journal of Special Education*.

Taylor, M. S., Mrstik, S., Dieker, L. A., Hynes, M. C., Hughes, C., & Straub, C.L. (under review). 4:1 positive praise microcredential: Using a virtual simulator to improve classroom management skills. *Simulation & Gaming*.

Taylor, M. S., Tucker, J., Donehower, C., Pabian, P., Dieker, L.A., Hynes, M.C., & Hughes, C. E. (under review). Impact of virtual simulation on the interprofessional communication skills of physical therapy students: A case series. *Journal of Physical Therapy Education*.

Taylor, R., & Buckridge, H. (under review). Avatars, interactors, and coaching feedback: Master's degree candidates' perception of effectiveness of mixed reality experiences. *International Journal of Educational Leadership Preparation*.

### **In Press:**

Dieker, L. A., Lingnugaris-Kraft, B., Hynes, M., & Hughes, C. E. (in press) Mixed reality environments in teacher education: Development and future applications. *American Council for Rural Special Educators*, Eds. B. Collins & B. Ludlow, in press.

### **2016:**

Barmaki, R., & Hughes, C. E. (2016). Towards the understanding of gestures and vocalization coordination in teaching context, *Educational Data Mining 2016 (EDM2016)*, June 29-July 2, Raleigh, NC., 663-665.

Barmaki, R. (2016). Improving Social Communication Skills Using Kinesics Feedback. *ACM Conference on Human-Computer Interaction (CHI 2016)*, May 7-12, San Jose, CA., 86-91. **(2nd Place Graduate Category, Microsoft Student Research)**

Chini, J. J., Straub, C. L., & Thomas, K. H. (2016). Learning from avatars: Learning assistants practice physics pedagogy in a classroom simulator. *Physical Review Physics Education Research* 12, 010117-1 -010117-

15. <http://journals.aps.org/prper/pdf/10.1103/PhysRevPhysEducRes.12.010117>

Hayes, A., & Hughes, C. E. (2016). Using human in the loop simulation in virtual and mixed reality for medical training. *22nd Medicine Meets VR Conference (NextMED/MMVR)*, April 7-9, Los Angeles, CA.

Hughes, C. E., Epstein, J. A., Hall, T., Ingraham, K. M., & Hughes, D. E. (2016). Enhancing protective role-playing behaviors through avatar-based scenarios, *4th International Conference on Serious Games and Applications for Health (IEEE SeGAH 2016)*, May 11-13, Orlando, FL. **(Best Paper Award)**

Hughes, C. E., & Ingraham, K. M. (2016). De-escalation training in an augmented virtuality space. *IEEE Virtual Reality (IEEE VR 2016)*, March 19-23, Greenville, SC, 181-182.

Jung, S. (2016). Physical presence aided by body ownership. *IEEE Virtual Reality (IEEE VR 2016) Doctoral Consortium*, March 19-23, Greenville, SC.

Nojavanasghari, B., Baltrusaitis, T., Hughes, C. E., & Morency, L-P. (2016). The future belongs to the curious: Towards automatic understanding and recognition of curiosity in children. *Workshop on Child Computer Interaction (WOCCI 2016)*, San Francisco, CA, September 6-7, 2016.

Patel, S., Hughes, D. E., & Hughes, C. E. (2016). MeEmo - Using an avatar to improve social skills in children with ASD. *Workshop on Child Computer Interaction (WOCCI 2016)*, San Francisco, CA, September 6-7, 2016.

## **2015:**

Barmaki, R. (2015). Multimodal assessment of Teaching Behavior in Immersive Rehearsal Environment – TeachLivE. *Proceedings of 17th International Conference on Multimodal Interaction (ICMI'15)*, 651- 655.

Barmaki, R. (2015). Multimodal Assessment of Teachers in Immersive Learning Environment. *Learning, Analytics and Knowledge Conference 2015 (LAK 2015)*, Poughkeepsie, NY, March 16-20, 2015.

Barmaki, R., & Hughes, C. E. (2015). Providing real-time feedback for student teachers in a virtual rehearsal environment. *Proceedings of 17th International Conference on Multimodal Interaction (ICMI'15)*, 531-537. **(People's Choice Grand Challenge Award)**

Barmaki, R., & Hughes, C. E. (2015). A Case Study to Track Teacher's Gestures in Virtual Learning Environments. *Learning, Analytics and Knowledge Conference 2015 (LAK 2015)*, Poughkeepsie, NY, March 16-20, 2015, 420-421.

Battista, N. U., & Boone, W.J. (2015). Exploring the Impact of TeachME Lab Virtual Classroom Teaching Simulation on Early Childhood Education Majors Self-Efficacy Beliefs. *Journal of Science Teacher Education*, 26:237-262.

Becht, K., & Delisio, L. (2015, June). The Lived Experiences of Middle School and High School Teachers Utilizing TeachLivE as a Professional Development Tool. In Bousfield, T., Hynes, M., Hughes, C., Straub, C., Dieker, L. & Ingraham, K. (Eds.), In Bousfield, T., Hynes, M., Hughes, C., Straub, C., Dieker, L. & Ingraham, K. (Eds.), [\*Proceedings of 3rd National TLE TeachLivE™ Conference 2015: Dissection Education\*](#), Orlando, FL: University of Central Florida, 2-6.

Behrens, C. & Franceschi, J. (2015, June). Year Two: TeachLivE for Instructional Coaches. In Bousfield, T., Hynes, M., Hughes, C., Straub, C., Dieker, L. & Ingraham, K. (Eds.), [\*Proceedings of 3rd National TLE TeachLivE™ Conference 2015: Dissection Education\*](#), Orlando, FL: University of Central Florida, 7-10.

Dieker, L. A., Delisio, L., & Bukaty, C. (2015). Tuning in with technology. In W. W. Murawski & K. L. Scott (Eds.), *What really works in elementary education: Research-based practical strategies for every teacher*. Thousand Oaks, CA: Corwin Press.

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Dieker, L. A., Hynes, M. C., Hughes, C. E., Hardin, S., & Becht, K. (2015). TLE TeachLivE (TM): Using Technology to Provide Quality Professional Development in Rural Schools. *Rural Special Education Quarterly* 34(3), 11-16.

Donehower, C. (2015, June). Using TeachLivE to Improve the Conversational Skills of Adolescents with Autism Spectrum Disorders. In Bousfield, T., Hynes, M., Hughes, C., Straub, C., Dieker, L. & Ingraham, K. (Eds.), [\*Proceedings of 3rd National TLE TeachLivE™ Conference 2015: Dissection Education\*](#), Orlando, FL: University of Central Florida, 11-18.

Hardin, S. & Freeman-Green, S. (2015, June). Infusing Culturally Responsive Strategies in STEM Instruction for Special Education Teachers. In Bousfield, T., Hynes, M., Hughes, C., Straub, C., Dieker, L. & Ingraham, K. (Eds.), [\*Proceedings of 3rd National TLE TeachLivE™ Conference 2015: Dissection Education\*](#), Orlando, FL: University of Central Florida, 19-22.

Hughes, C. E., Nagendran, A., Dieker, L. A., Hynes, M. C., & Welch, G. F. (2015). Applications of Avatar-Mediated Interaction to Teaching, Training, Job Skills and Wellness. In B. Burnett, R. van Liere, & G. Welch (Eds.), *Virtual Realities: Lecture Notes in Computer Science*, 8844, Zug, Switzerland: Springer. 133-146.

Ingraham, K. & Hughes, C. E. (2015). CollegeLiVE: Using avatar training to promote protective behaviors on college campuses. *Proceedings of Association for Educational Communications and Technology (AECT 2015)*, Indianapolis, IN, November 2-7.

Nagendran, A., Welch, G. F., Hughes, C. E., & Pillat, R. (2015). Exploring Human Surrogate Characteristics. In *Virtual Realities: Lecture Notes in Computer Science*, 8844. 215-238.

Regalla, M., Nutta, J., Hutchinson, C., & Ashtari, N. (2015, June). English Language Learner (ELL) Avatars for Pre-Service Teachers. In Bousfield, T., Hynes, M., Hughes, C., Straub, C., Dieker, L. & Ingraham, K. (Eds.), [\*Proceedings of 3rd National TLE TeachLivE™ Conference 2015: Dissection Education\*](#), Orlando, FL: University of Central Florida, 23-26.

Storey, V. A., & Cox, T. (2015). Utilizing Teach LivE™ (TLE) to build educational leadership capacity: The development and application of virtual simulations. *Journal of Education and Human Development*. (4)2, 41-49. <http://jehdnet.com/vol-4-no-2-june-2015-jehd>

Storey, V. A., & Dambo, N. (2015). Totally immersive environment as an instructional tool for building educational leadership capacity: Is this the future? In V.C.X. Wang & V.C. Bryan (Eds.), *Handbook of Research on Learning Outcomes and Opportunities in the Digital Age*. Hershey, PA: IGI Global. <http://www.igi-global.com/book/handbook-research-learning-outcomes-opportunities/134816>

Straub, C., Dieker, L., Hynes, M., And Hughes, C. (2015, June). Using Virtual Rehearsal in TLE TeachLivETM Mixed Reality Classroom Simulator to Determine the Effects on the Performance of Science Teachers: A Follow-up Study (Year 2). In Bousfield, T., Hynes, M., Hughes, C., Straub, C., Dieker, L. & Ingraham, K. (Eds.), [\*Proceedings of 3rd National TLE TeachLivE™ Conference 2015: Dissection Education\*](#), Orlando, FL: University of Central Florida.

Taylor, M. & Stone, S. (2015, June). Microcredential: 4:1 Positive Praise Strategy. In Bousfield, T., Hynes, M., Hughes, C., Straub, C., Dieker, L. & Ingraham, K. (Eds.), [\*Proceedings of 3rd National TLE TeachLivE™ Conference 2015: Dissection Education\*](#), Orlando, FL: University of Central Florida, 33-37.

Thompson, J. & Kosiorek, C. (2015, June). Video Recording Instructional Coaching: An Effective Strategy to Improve Teaching. In Bousfield, T., Hynes, M., Hughes, C., Straub, C., Dieker, L. & Ingraham, K. (Eds.), [\*Proceedings of 3rd National TLE TeachLivE™ Conference 2015: Dissection Education\*](#), Orlando, FL: University of Central Florida, 38-40.

Wallace, L. & Whitten, E. (2015, June). Utilizing TeachLivE As a Component of a Multi-Tiered Approach to Preservice Teacher Preparation. In Bousfield, T., Hynes, M., Hughes, C., Straub, C., Dieker, L. & Ingraham, K. (Eds.), [\*Proceedings of 3rd National TLE TeachLivE™ Conference 2015: Dissection Education\*](#), Orlando, FL: University of Central Florida, 41-47.

## 2014:

Barmaki, R. (2015). Nonverbal Communication and Teaching Performance. *Proceedings of the 7th International Conference on Educational Data Mining (EDM)*. London, 441-443.

Behrens, C., & Franceschi, J. (2014, May). TeachLivE for Instructional Coaches: Uses and Takeaways from District and Trainer Perspectives. In Straub, C., Dieker, L., Hynes, M. & Hughes, C. (Eds.), [\*Proceedings from the 2nd Annual TLE TeachLivE™ Conference 2014: Ludic Convergence\*](#), Orlando, FL: University of Central Florida, 3-5.

Brandenburg, L., Donehower, C., & Rabuck, D. (2014, May). How TeachLivE is Helping Kennedy Krieger Build Model Classrooms. In Straub, C., Dieker, L., Hynes, M. & Hughes, C. (Eds.), [\*Proceedings from the 2nd Annual TLE TeachLivE™ Conference 2014: Ludic Convergence\*](#), Orlando, FL: University of Central Florida, 6-10.

Buckridge, H., & Taylor, R. (2014, May). M. Ed. in educational leadership practice & coaching in TeachLivE™: Preliminary findings. In Straub, C., Dieker, L., Hynes, M. & Hughes, C. (Eds.), [\*Proceedings from the 2nd Annual TLE TeachLivE™ Conference 2014: Ludic Convergence\*](#), Orlando, FL: University of Central Florida, 11-14.

Dieker, L. A., Kennedy, M. J., Smith, S., Vasquez III, E., Rock, M., & Thomas, C. N. (2014). *Use of technology in the preparation of pre-service teachers* (Document No. IC-11). University of Florida, Collaboration for Effective Educator, Development, Accountability, and Reform Center <http://ceedar.education.ufl.edu/tools/innovation-configurations/>

Dieker, L.A., Rodriguez, J., Lingnugaris-Kraft, B., Hynes, M., & Hughes, C.E. (2014). The future of simulated environments in teacher education: Current potential and future possibilities. *Teacher Education and Special Education*, 37(1), 21-33. **(2015 Publication Award from the Teacher Education Division of the Council for Exceptional Children)**

Dieker, L.A., Straub, C., Hughes, C., Hynes, M.C., & Hardin, S.E. (2014). Virtual environments can take us virtually anywhere. *Educational Leadership*, 71(8), 54-58.

Eisenreich, H., & Harshman, K. (2014, May). The influence of TeachLivE on anxiety levels in preservice and inservice mathematics teachers. In Straub, C., Dieker, L., Hynes, M. & Hughes, C. (Eds.), [\*Proceedings from the 2nd Annual TLE TeachLivE™ Conference 2014: Ludic Convergence\*](#), Orlando, FL: University of Central Florida, 15-19.

Erbiceanu, E., Mapes, D., & Hughes, C.E. (2014). Modeling attention and interaction in small groups of virtual characters. *Non-Verbal communication in Virtual Worlds*, Eds. J. Tanenbaum, M. Nixon & M. Seif el-Nasr, ETC Press, Carnegie-Mellon.

Hayes, A. (2014, May). Measuring social presence and impact of social presence in TeachLivE: ludic convergence. In Straub, C., Dieker, L., Hynes, M. & Hughes, C. (Eds.), [\*Proceedings from the 2nd Annual TLE TeachLivE™ Conference 2014: Ludic Convergence\*](#), Orlando, FL: University of Central Florida, 20-23.

Nagendran, A., Pillat, R., Kavanaugh, A., Welch, G., & Hughes, C.E. (2014). A unified framework for individualized avatar-based interactions. *Presence: Teleoperators and Virtual Environments* 23(2), 109-132.

Regalla, M., Nutta, J.A., Hutchinson, C.J., Jones, P., Ashtari, N., & Verkler, K. (2014, May). English learner (EL) avatars for pre-service teachers. In Straub, C., Dieker, L., Hynes, M. & Hughes, C. (Eds.), [\*Proceedings from the 2nd Annual TLE TeachLivE™ Conference 2014: Ludic Convergence\*](#), Orlando, FL: University of Central Florida, 24-28.

Rodriguez, J. (2014, May). Comparison of feedback methods for pre-service teachers delivering mathematics lessons in the TeachLivE lab. In Straub, C., Dieker, L., Hynes, M. & Hughes, C. (Eds.), [\*Proceedings from the 2nd Annual TLE TeachLivE™ Conference 2014: Ludic Convergence\*](#), Orlando, FL: University of Central Florida, 29-33.

Straub, C., Dieker, L., Hynes, M., & Hughes, C. (Eds.). (2014). [\*Proceedings from TeachLivE 2014: 2nd National TLE TeachLivE Conference\*](#). Orlando, FL: University of Central Florida.

Straub, C., Dieker, L., Hynes, M., & Hughes, C. (2014). [\*Using virtual rehearsal in TLE TeachLivE™ mixed reality classroom simulator to determine the effects on the performance of mathematics teachers\*](#). 2014 TeachLive National Research Project: Year 1 Findings. University of Central Florida: Orlando, FL.

Vasquez, E., Straub, C., Nagendran, A., Marino, M. T., Welch, G., Hughes, C. E., Russell, M., Koch, A., Delisio, L., Alias, A., Paz, M., Schaffer, K., & Silva, J. (2014, May). A comparison of feedback methods for pre-service teachers delivering mathematics lessons in the TeachLivE™ lab. In Straub, C., Dieker, L., Hynes, M. & Hughes, C. (Eds.), [\*Proceedings from the 2nd Annual TLE TeachLivE™ Conference 2014: Ludic Convergence\*](#), Orlando, FL: University of Central Florida, 34-37.

## **2013:**

Dieker, L. A., Lingnugaris-Kraft, B., Hynes, M., & Hughes, C. E. (2013). Mixed reality environments in teacher education: Development and future applications. *American Council for Rural Special Educators*. Lexington, KY: ACR SE.

Hayes, A., Hardin, S., Dieker, L., Hynes, M., & Hughes, C., & Straub, C. (Eds.). (2013). *Proceedings from TeachLivE 2013: 1st National TLE TeachLivE Conference*. Orlando, FL: University of Central Florida.

Hayes, A., Hardin S., & Hughes, C. E. (2013). Perceived presence's role on learning outcomes in a mixed reality classroom of simulated students. *Lecture Notes in Computer Science*, 8022, Springer-Verlag, Heidelberg, 142-151.

Hayes, A. T., Straub, C. L., Dieker, L. A., Hughes, C. E., & Hynes, M. C. (2013). Ludic learning: exploration of TLE TeachLivE™ and effective teacher training. *International Journal of Gaming and Computer-Mediated Simulations*, 52(2), 23-26.

Nagendran, A., Pillat, R., Kavanaugh, A., Welch, G., & Hughes, C. E. (2013). AMITIES: Avatar-Mediated Interactive Training and Individualized Experiences System. *Virtual Reality Software & Technology (VRST) 2013*, Singapore, October 6-8, 2013, 143-152.

## **2012:**

Dieker, L., Hynes M., Ludlow, B., & Whitten, W. (2012, February). Evolving environments in learning: The TLE TeachLivE™ experience. *The American Association of Colleges for Teacher Education*, Chicago, IL.

Hughes C. E., & Mapes, D. P. (2012). Mediated dialogues through multiple networked avatars. *Proceedings of Immersive Education 2012 (iED 2012)*, Boston, Ma, June 14-16), 10-18.

Lopez, A. L., Hughes, C. E., Mapes D. P., & Dieker, L. A. (2012). Cross cultural training through digital puppetry. *Advances in Design for Cross-Cultural Activities Part I*, Chapter 25, Edited by Denise M. Nicholson, CRC Press 2012, 247-256.

Nagendran, A., Pillat, R., Hughes, C. E., & Welch, G. (2012). Continuum of virtual-human space: Towards improved interaction strategies for physical-virtual avatars. *ACM SIGGRAPH VRCAI 2012*, Dec. 2-4, 2012, Singapore, 135-142.

## **Grants Tied to TeachLivE:**

Bousfield, T., Hynes, M., Dieker, L., & Hughes, C. (2016). *TeachLivE™ Proposal for 3 elementary student avatars designed for both flat display and a 360° environment*. Bert W. Martin Foundation, \$124,000 funded.

Lukens, J., Ericksson, G., Bai, H., & Nutta, J. (2015). *ELEVATE: English Learner Excellence eVolving through Advanced Teacher Education*. Javits Gifted and Talented Students Education Program #5206A150014. \$1,057,546 (UCF budget 50%).

Dieker, L. A., Hynes, M., & Hughes, C. (2015). *TLE TeachLivE elementary avatars with autism and intellectual disabilities*. Bert Martin Foundation, \$65,000 funded.

Dieker, L. A., Straub, C., Hynes, M., Stone, S., & Taylor, M. (2015). *Micro-credentialing Project*. Charles and Lynn Schusterman Family Foundation, \$5,000 funded.

Dieker, L. A., Hynes, M., & Hughes, C. (2015). *TLE TeachLivE avatars with autism and intellectual disabilities*. Bert Martin Foundation, \$40,000 funded.

Hynes, M., Dieker, L. A., & Hughes, C. (2013). *TeachLivE™ Development*, New Schools Ventures, \$190,000 funded.

### **Doctoral Dissertations:**

Barmaki, R. (2016). *Gesture Assessment of Teachers in an Immersive Rehearsal Environment*. Ph.D., Computer Science, University of Central Florida, August 2016.

Buckridge, H. (2016). *Mixed reality experiences in the M. Ed. educational leadership program: Student perceptions*. Ph.D., Education & Human Performance, University of Central Florida, May 2016.

Bukaty, C. (2016). *Effects of Mixed-reality Peer Interactions on Workplace Problem-solving of Individuals with Intellectual Disabilities*. Ph.D., Education & Human Performance, University of Central Florida, May 2016.

Gallegos, B. (2016). *The Role of Virtual Avatars in Supporting Middle School Students with Learning Disabilities from Culturally and Linguistically Diverse Backgrounds in After School Programs on Science*. Ph.D., Education & Human Performance, University of Central Florida, May 2016.

Hayes, A. (2015). *The Experience of Presence and Social Presence in a Virtual Learning Environment as Impacted by the Affordance of Movement Enabled Motion Tracking*. Ph.D., Modeling & Simulation, University of Central Florida, August 2015.

Hughes, D. (2014). *The Design and Evaluation of a Game to Help Train Perspective-Taking and Empathy in Children with Autism Spectrum Disorder*. Ph.D., Modeling & Simulation, University of Central Florida, May 2014.

Ingraham, K. (2014). *Examining Emotional Responses to effective Versus Ineffective Virtual Buddies*. Ph.D., Education & Human Performance, University of Central Florida, May 2014.

Lopez, A. (2012). *Teacher's perceptions of Latino males with behavior disorders in virtual environments*. Ph.D., Education & Human Performance, University of Central Florida, May 2012.

Vince-Garland, K. (2012). *Teaching teachers to use discrete trial training in a virtual teaching environment*. Ph.D., Education & Human Performance, University of Central Florida, August 2012.

Walker, Z. (2012). *Providing coaching on employability skills for students with intellectual disabilities in a virtual environment*. Ph.D., Education & Human Performance, University of Central Florida, August 2012.

## **Presentations:**

Buckridge, H. (2016, March). *TeachLivE*, International Conference on Professional Doctorates, Belfast, Ireland.

Buckridge, H., & Taylor, R. T. (2015, June). *Mixed reality experiences in the preparation of assistant principals: Students' perspectives*. TLE TeachLivE™ Conference, Orlando, FL.

Bukaty, C., Stone, S., & Dieker, L. (2015, November). *TeachLivE three years research data and outcomes*. Council for Exceptional Children Teacher Education Division, Tempe, AZ.

Brand, B., Hassell, J., Chard, D., & Dieker, L. (2014, July). Panel Member: *Getting to the core: Implementing college and career ready standards!* U.S. Department of Education Special Education Programs Leadership Conference, Washington, D.C.

Dieker, L. (2016, January). *Keynote: Embracing technology to ensure the success of ALL citizen*. The Future is here for Early Learning: Barbara Bush Foundation, West Palm, Florida.

Dieker, L. (2015, November). *Panel Member: Vision for teacher preparation, 40<sup>th</sup> Anniversary IDEA Celebration*, Washington, DC.

<http://edstream.ed.gov/webcast/Play/5948bd4d0065424d8a04c2cdd61745d31d> at 1:21:30 in presentation.

Dieker, L. A. (2015, October). *Using simulation and technology in teacher education in research*. Distinguished Lecturer, Normal Taiwan University, Taipei, Taiwan.

Dieker, L. A. (2015, October). *Keynote: Innovations and practical applications of current and emerging technology and simulations in education*. Distinguished Lecturer, Normal Taiwan University, Taipei, Taiwan.

Dieker, L. (2015, May). *Featured Presentation: TeachLivE simulated classroom environment*, Learning Forward Professional Development Brain Trust, St. Petersburg, Florida.

Dieker, L. (2015, April). *Innovations and practical applications of current and emerging technologies in teacher education: Are we and our teachers prepared?* Cooper Distinguished Lecture Series, University of Virginia, Charlottesville, VA.

Dieker, L. (2015, March). *Innovative technology in teacher education*. CEEDAR Center University of Florida, National Webinar.

Dieker, L. A. (2014, November). *Mentoring and using technology in doctoral preparation*. United States Office of Special Education Programs, Washington, D.C.

Dieker, L. A. (2014, October). *Increasing student engagement through technology and evidence-based practices while maintaining high standards*. Special Education Forum 2014: Holistic Care for Students with Special Educational Needs, University of Macau, Macau, China.

Dieker, L. A. (2014, October). *Increasing student engagement through technology and evidence-based practices while maintaining high standards*. Special Education Forum 2014: Holistic Care for Students with Special Educational Needs, University of Macau, Macau, China.

Dieker, L. (2014, October). Potential of emerging technologies including fully immersive simulation. American Speech and Language Association, Orlando, FL.

Dieker, L. (2014, May). *Keynote: Preparation of the next generation of learners: Innovative and practical application of current and emerging technology*. SUNY New Paltz Visiting Scholar Lecture, New Paltz, NY.

Dieker, L. (2014, April). *Preparation of the next generation of learners: Innovations and practical application of current and emerging technology*. University of Virginia Cooper Distinguished Lecture Series, Charlottesville, VA.

Dieker, L. (2014, January). *Keynote: Creating a new future for ALL learners through collaboration, inclusion and technology*. Indiana IEP Conference, Indianapolis, IN.

Dieker, L. (2014, January). *Keynote: Preparation of the next generation of learners: Innovative and practical application of current and emerging technology*. National Association Private Special Education Centers Leadership Conference, New Orleans, LA.

Dieker, L. (2013, December). *Keynote: Preparation of the next generation of teachers using current and emerging technology*. Pittsburgh University, Pittsburgh, PA.

Dieker, L. (2013, December). *TLE TeachLivE™ implications for teacher preparation and retooling*. New Schools Teacher Learning Summit, Washington, DC.

Dieker, L. A. (2013, July). *Preparation of next generation of learners using technology*. Southeastern Consortium of Minority Engineers, Emory Riddle, Daytona Beach, FL.

Dieker, L. A. (2013, March). *Keynote: The future of virtual in Rural Teacher education*. ACRES Conference, Orlando, FL.

Dieker, L. (2012, December). *Transitioning to personalized, effective professional development: TeachLivE™*. Teacher Voice Convening: Accelerating Our Scale and Impact the Bill & Melinda Gates Foundation, Seattle, WA.

Dieker, L. A. (2011, May). *Panel member: Future technologies and education*. Institute of Applied Technology, Abu Dhabi, United Arab Emirates.

Dieker, L. A. (2011, May). *Keynote: Virtual teacher preparation*. Institute of Applied Technology, Abu Dhabi, United Arab Emirates.

Dieker, L. A. (2011, October). *Keynote: The future of virtual environments for teachers and students*. University of Central Florida Town and Gown, Orlando, FL.

- Dieker, L., Delisio, L., Kennedy, M., Basham, J., & Deshler, D. (2014, April). *Future technologies for special educators in STEM*. Council for Exceptional Children Annual Conference, Philadelphia, PA.
- Dieker, L., & Fitzgerald, G. (2013, November). *Research Spotlight: Research in teacher education*. Council for Exceptional Children Teacher Education Division, Ft. Lauderdale, FL.
- Dieker, L., & Hynes, M. (2012, December). *Virtual classrooms: The possibilities and impact to retrain and retool practicing teachers*. Learning Forward: Innovative Professional Development Conference by the Bill & Melinda Gates Foundation, Boston, MA.
- Dieker, L., & Hynes, M. (2012, December). *TLE TeachLivE™ showcase*. Learning Forward: Innovative Professional Development Conference by the Bill & Melinda Gates Foundation, Boston, MA.
- Dieker, L., Hynes M., Ludlow, B., & Whitten, W. (2012, February). *Evolving environments in learning: The TLE TeachLivE™ experience*. The American Association of Colleges for Teacher Education, Chicago, IL.
- Dieker, L., Ludlow, B., Lignugaris-Kraft, B., & Spencer, S. (2013, April). *Research outcomes of TeachLivE*. Council for Exceptional Children, Denver, CO.
- Dieker, L., Rodriquez, J., Hardin, S., & Lopez, A. (2012, July). *Future of technology in teacher education: The TeachLivE™ Experience*. U.S. Department of Education Office of Special Education Program Project Officers Meeting, Washington, DC.
- Dieker, L., Rodriquez, J., Hardin, S., & Lopez, A. (2012, April). *Future of technology in teacher education*. Council for Exceptional Children, Denver, CO.
- Dieker, L., Serianni, B., Hardin, S., & Whitten, L. (2013, November). *Current and future technologies in teacher education*. Council for Exceptional Children Teacher Education Division, Ft. Lauderdale, FL.
- Dieker, L. A., & Smith, S. (2013, July). *Past, present and future technologies in teacher education*. 2013 Office of Special Education Program Projects Director's Conference, Washington, DC.
- Dieker, L., Straub, C., & Becht, K. (2014, November). *Getting to the Common Core: Supporting special educators' conceptual knowledge with virtual rehearsal*. Council for Exceptional Children Teacher Education Division, Indianapolis, IN.
- Hughes, C. E. (2015). *Avatars and Surrogates: Remote Presence for Improved Collaboration, Education, and Healthcare*. Invited presentation at *International Crisis and Risk Management Conference ICRC 2015*, Orlando, FL, March 3, 2015.

Hughes, C. E. (2014). Human Surrogates: Remote Presence for Collaboration and Education in Smart Cities. Keynote presentation at *ACM Multimedia 2014 1st International Workshop on Emerging Multimedia Applications and Services for Smart Cities (EMASC-2014)*, Orlando, FL, November 7, 2014

Hutchinson, C. J., Nutta, J., Regalla, M., & Ashtari, N. (2016, June). *How TeachLivE™, a mixed-reality classroom, impacted PK-12 teacher candidates' beliefs and knowledge about English learners*, 3<sup>rd</sup> Annual TeachLivE™ International Conference, UCF, Orlando, Florida <http://teachlive.org/gallery/june-2015-annual-teachlive-conference/>

Hutchinson, C.J., Nutta, J., & Regalla, M. (2016, February). How TeachLivE™, a mixed-reality classroom impacted PK-12 teacher candidates' beliefs and knowledge about English learners. AACTE Conference, Las Vegas, NV <http://aacte.org/>

Hutchinson, C.J., Nutta, J., Brooks, L., & Ashtari, N. (2015, October). *Avatars, not just for gaming: Teacher candidates gain valuable insights through interactions with simulated English language learners*. Florida Association of Teacher Educators Annual Meeting, Gainesville, Florida. <http://Fate1.org>

Hynes, M. (2016, February). Applications of a virtual reality classroom in mathematics education, The John Wilson Memorial Lecture, Annual Conference of the Research Council for Mathematics Learning. Orlando, Florida.

Hynes, M., Bousfield, T., & Fulchini, A. (2016, January). TeachLivE™: A virtual sandbox for teacher preparation and student learning. Share Fair Nation, University of Central Florida, Orlando, Florida.

Hynes, M., & Dieker, L. (2015, April). TeachLivE: A virtual sandbox for teacher preparation and student learning. Share Fair Nation, George Washington University, Washington, D.C.

Hynes, M., Bousfield, T., & Bukaty, C. (2015, March). TeachLivE: A virtual sandbox for teacher preparation and student learning. Share Fair Nation, University of South Carolina.

Kennedy, M., Thomas, C., Rock, M., & Dieker, L. (2015, November). *Innovations in technology and teacher preparation*. Council for Exceptional Children Teacher Education Division, Tempe, AZ.

Ingraham, K, & Hughes, C. E. (2015). CollegeLiVE: Using avatar training to promote protective behaviors on college campuses. *Proceedings of Association for Educational Communications and Technology (AECT 2015)*, Indianapolis, IN, November 2-7

Lignugaris/Kraft, B., Dawson, M., Harris, S., & Dieker, L. (2014, November). *Using virtual learning environments to develop teaching skills: Training and generalized effects*. Council for Exceptional Children Teacher Education Division, Indianapolis, IN.

Ludlow, B., Dieker, L., & Elford, M. (2012, April). *Research from the TLE TeachLivE™ experience*. Council for Exceptional Children, Denver, CO.

Straub, C., Dieker, L., & Hardin, S. (2012, November). *Future and possibilities for teacher preparation: range of feedback tools including video coding in virtual classrooms*. Presented at Teacher Education Division, Council for Exceptional Education, Grand Rapids, MI.

Walters, C., & Nutta, J. (2015, June). *The circle of Live: Engaging virtual English learners (ELs) in reading circle activities*, 3<sup>rd</sup> Annual National TeachLivE Conference, UCF, Orlando, Florida.

Walters, C. (2014, May). *Keeping it real in a mixed reality environment*, Faculty Center for Teaching and Learning Summer Conference, UCF, Orlando, Florida.

### **Digital Presentations or Publications**

Dieker, L. A., Stone, S., & Gallegos, B. (2015). Instructional practice, professional development and microcredentials. *United States Department of Education: Office of Special Education Programs Virtual Conference Personnel Preparation Breakout Session Feature Video*.

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