ISSN 2167-3454

JOSEA

THE JOURNAL OF SPECIAL EDUCATION APPRENTICESHIP

Vol. 12(1) January 2023

Functional Analysis in Simulated Environments

Claire Donehower Paul[1], Jennifer Walker[2], Cathy Thomas[3], Matthew S. Taylor[4], Jamie Best[5], Morgan Diaz[5], Chad A. Rose[6], and Eleazar Vasquez[5]

[1]Georgia State University
[2]University of Mary Washington
[3]Texas State University
[4]Salve Regina University
[5]University of Central Florida
[6]University of Missouri

The need for highly effective and qualified special educators continues to be a national concern. One of the primary reasons why teachers leave the profession is a lack of effective behavior management skills. Learning how to assess challenging behavior and its causes through functional analysis is one method to enhance teacher skillset in this critical area. The purpose of this study was to investigate the use of a simulation environment to train pre-service and in-service general and special education teachers to conduct functional analysis procedures with fidelity and compare those results to traditional didactic instruction. The results of the study show that simulated rehearsal experiences can be as effective as traditional role play experiences in training teachers to implement functional analysis procedures and may have added benefits such as increased safety and access to immediate feedback and coaching.

Keywords: functional analysis, simulation, technology, teacher preparation

Author Note:

Correspondence concerning this manuscript should be addressed to Claire Donehower Paul at cdonehower@gsu.edu. The contents of this publication were developed under a grant from the US Department of Education, H325K150201. However, those contents do not necessarily represent the policy of the US Department of Education, and you should not assume endorsement by the Federal Government. Project Officer, Celia Rosenquist.

The need for highly effective and qualified special educators is a national concern. According to the 39h Annual Report to Congress from the United States Department of Education (USDOE, 2018), data for teachers employed to provide special education and related services to students ages 6 through 21 under Individuals with Disabilities Education Act (IDEA), Part B, for fall 2013 revealed that nationally there were only 6.5 full-time equivalent special education teachers per 100 students. Of those special educators, 6.5% were not fully certified.

Evidence showing improved outcomes for children with disabilities who receive specialized and intensive intervention (Alexander et al., 2015; Reichow, 2011) highlights the critical and immediate need for special educators and service providers with expertise to address the extreme variability and complex nature of children with disabilities (Barnhill et al., 2014; Coblentz, 2017). Unfortunately, issues with personnel preparation have been consistently identified as challenges to effective programming for children with disabilities (Brock et al., 2014; National Reading Council, 2001). Further, trends in special education toward multi-categorical preparation have resulted in teacher education programs with limited time to provide disability specific information (Obiakor et al., 2014; Tetzloff & Obiakor, 2015).

Every Student Succeeds Act (ESSA, 2015) included amendments to implementation of statutory provisions regarding state, local educational agency (LEA), and school accountability for the academic achievement of students with the most significant disabilities. A major barrier to improving educational outcomes for students with disabilities is limited application of high leverage practices (HLPs) for teaching and supporting this population of youth. Special educators must be prepared to implement HLPs with fidelity as well as recommend and justify the use of HLPs to parents, educators, and administrators (Kennedy et al., 2017; Rock et al., 2016). Jones and West (2009) assert teacher preparation courses need to be linked to a research base reflective of and sensitive to the challenges of students with intricate sensory, cognitive, and behavioral needs.

Training in applied behavior analysis (ABA) is a critical need for teachers serving students with disabilities. Strategies based on ABA principles are prominent in every accumulation of HLPs for students with disabilities. According to the National Professional Development Center (2016), there is an overwhelming amount of research indicating strategies rooted in ABA (e.g., modeling, prompting, imitation, reinforcement, self-monitoring) are the most efficacious for skill acquisition instruction for children with disabilities. Focus on the development and mastery of these competencies through intensive clinical supervision is an important component of teacher preparation. Recent research has placed a high value on the inclusion of practicum or field experiences, as they are impactful and positively affect the quality of training programs (Konrad et al., 2011; Novak et al., 2009; Palmen et al., 2010; Wei & Yasin, 2017). Stahmer and colleagues (2015) demonstrated individualized coaching for 20 teachers in the use of pivotal response training (PRT) procedures was more effective than workshops alone. There is a clear need to develop more advanced instruction, rehearsal, and coaching practice in the area of behavior management, schedules of reinforcement, and functional assessment/analysis techniques.

Functional Analysis in Personnel Preparation

According to the National Commission on Teaching and America's Future (NCTAF, 2007), the cost of teacher turnover is substantial, ranging from $4,000 to $15,000 per teacher for recruiting, hiring, and training a replacement teacher. While the financial burden of high teacher turnover is a concern, the associated impact on student achievement is even more troubling. Given the link between difficulty managing challenging behavior in the classroom and teacher attrition, there is a need for teacher preparation in the area of functional analysis procedures to help educators better assess and intervene on these behaviors.

Functional analysis (FA) is a systematic procedure for identifying a behavioral function (Iwata & Dozier, 2008). It is most useful when the function may be challenging to identify (Iwata & Dozier, 2008), or more than one function is possible (Pennington et al., 2017). However, conducting FA is particularly critical for cases in which children may engage in behaviors which significantly disrupt their learning or the learning of others, and in cases of high-risk behaviors that impact the child's safety or the safety of others. Functional analysis is important because accurately identifying behavior function is directly linked to successful treatment (Iwata et al., 1994). For example, in a recent synthesis of behavioral interventions for persons with autism that included 213 studies and 358 respondents, Heyvaert and colleagues (2014) found that of the 71.8% of the time an FA was conducted prior to intervention and that the inclusion of an FA resulted in statistically significant reductions in challenging behavior when compared to cases in which no FA was implemented.

Functional analyses are often conducted by highly trained personnel such as behavior analysts, school psychologists, and behavior specialists (Iwata & Dozier, 2008). While simple to conduct (Gable et al., 2012), FAs require a high degree of fidelity to procedures (Iwata et al., 2000), and since the FA will occasion the target behavior, expertise in positive behavior supports and behavior management may also be important for safety reasons (Iwata & Dozier, 2008; Mueller et al., 2011; Pennington et al., 2017). The need for technical accuracy in implementation raises questions about how to best train personnel to conduct FAs. Further, while specialists are most often called upon to conduct FAs, such trained personnel are not always available (Mueller et al., 2011). For these reasons, it is logical to offer training on conducting FA procedures to teachers (Mueller et al., 2011).

There is evidence to support the inclusion of FA training into the preparation of teachers (e.g., Austin et al., 2015; Bloom et al., 2011; Mueller et al., 2011; Pence et al., 2014; Vasquez et al., 2017). In a synthesis by Mueller and colleagues (2011), 80% of FAs were conducted by behavior specialists, with the remaining analyses conducted by teachers. Special education teachers are most often trained to conduct FAs, but general educators were also successfully trained (Koch et al., 2014; Moore et al., 2002; Wallace et al., 2004). There are several methods to instruct teachers how to conduct FAs. FA trainings tended to include didactic instruction in principles of ABA, behavioral function, and FA history and techniques (e.g., Erbas et al., 2006; Vasquez et al., 2017). Further, teachers were often asked to complete additional readings to enhance their background knowledge (Erbas et al., 2006; Moore et al., 2002; Mrstik et al., 2018; Wallace et al., 2004).

For skill development, traditional methods in the literature included modeling, role play, and in situ practice with direct observation. However, researchers are also exploring the use of technology including video models of expert practice, video recordings of practice with direct observation, teleconferencing, and simulation to enhance training procedures (Rock et al., 2016; Vasquez et al., 2017). Modeling enabled teachers to observe conditions of an FA conducted by an expert with fidelity (Moore et al., 2002; Wallace et al., 2004). The use of role play for skill development was commonly employed as well (Moore et al., 2002; Wallace et al., 2004). In descriptions of role play procedures, teachers were assigned a partner and alternated between the roles of the student who engaged in the challenging behavior and the clinician conducting the FA. Teachers followed scripted protocols in which the experimental conditions and the frequency, intensity, and duration of the operationally defined behavior were prescribed by the instructor. Feedback was provided to role play participants with attention to fidelity of performance. Some studies employed in vivo practice with direct observation of implementer fidelity (Bloom et al., 2013; Moore et al., 2002; Wallace et al., 2004).

Video models of expert practice were also employed by several researchers (Erbas et al., 2006; Iwata et al., 2000; Lambert et al., 2014; Wallace et al., 2004). In some cases, researchers videotaped participants as they conducted FA procedures in the field and used the video to provide feedback on the trainee's performance (Erbas et al., 2006). Machalicek and colleagues (2008) used synchronous video technology to provide remote training and practice to teachers, including synchronous, direct observation of teacher-student dyads followed by expert feedback. Vasquez and colleagues (2017) explored the use of simulation to train general and special education teachers on FA procedures. The current study replicates and extends the work by Vasquez and colleagues (2017) use of simulated environments to instruct teachers in the use of FA procedures.

Simulation

Simulation has many potential benefits as a component of FA training procedures. First, even skilled FA implementation by an expert implementer by definition will occasion challenging behaviors with the potential for disruptions to learning and safety (Pennington et al., 2017). Second, ethical treatment of children suggests that educators limit exposure and explore alternative options for novice teachers' trial and error learning on real children (Thomas et al., 2012). Third, just as students learn at differential rates, so do teachers (Thomas et al., 2012), and some teachers who master FA with a high level of fidelity will not adopt the practice due to issues related to their perceptions of its feasibility, utility and/or consonance with their beliefs about behavioral practices (Cook et al., 2008). Finally, while it is possible to train teachers to fidelity, studies that examine durability have observed post-study declines in fidelity (Machalicek et al., 2010), suggesting a need for access to review and coaching in the field (Cook et al., 2008; Joyce & Showers, 2002). Although existing traditional and technology-based training components do offer affordances for learning, each has limitations. For example, asynchronous video allows for deep and repeated noticing of critical features, but it is static and does not allow for interactive practice (Bransford et al., 2000). Synchronous video requires the presence of all participants and often/should requires specialized consents from parents to allow for video recording of their child for purposes of teacher learning (Vasquez & Slocum, 2004; Vasquez & Straub, 2015).

Simulation has been used widely in other fields for training with successful results. For example, in a study on laparoscopic surgery, Aggarwal and colleagues (2007) found that simulation training resulted in a shortened learning curve for surgeons in training. Flight simulation is routinely used to improve flight safety and operations (Shy et al., 2002).

With respect to simulation in teacher preparation, the results of a large national research study using the TeachLivE™ simulator, which included more than 150 practicing teachers, indicated that four 10-minute sessions in the simulator impacted at least one pedagogical skill or teacher behavior transferring back to the “real” classroom (Straub et al., 2014; 2015). Virtual learning systems have the potential to provide situated, contextualized, and sustained opportunities for practice while protecting real children (Bransford et al., 2000; Dieker et al., 2014).

The TeachLivE™ simulator is a mixed reality experience that immerses the participants in a variety of settings ranging from multi-student classroom, one-on-one setting with a child, or in a one-on-one setting with an adult, using avatars that respond in real-time and are controlled by an interactor (Straub et al., 2014). TeachLivE™ was developed with the intent of supporting the development and mastery of specific teaching skills in pre-service before entering the classroom. This technology allows professors or administrators to develop engaging scenarios with virtual practice opportunities to allow students to rehearse pedagogical skills prior to interacting with real students in real classrooms (Straub et al., 2014). Empirical studies on TeachLivE™ suggest that these skills are generalizable to the regular classroom (Straub et al., 2014; Straub et al., 2015). TeachLivE™ has been used to target skills such as asking open-ended questions, accessing higher-order thinking skills, providing opportunities for students to respond, and parent conferencing (Straub et al., 2014; 2015).

The purpose of this study was to investigate the use of simulation to train pre-service and in-service general and special education teachers to conduct an FA with fidelity and in a manner that was safe for children and teachers, time efficient, and reliable across participants and settings (e.g., scalable). The present study was guided by the following research question: Does didactic instruction combined with rehearsal in a simulated environment result in higher fidelity to FA procedures when compared to didactic instruction combined with traditional role play?

Method

Participants

Eighty-three students enrolled in teacher preparation programs consented to participate. The participants ranged in age from 19 to 54 years old. The majority of participants had either no previous ABA coursework (35%) or had taken one course, which covered ABA principles (36%). A smaller percentage of students had taken two to three courses (14%), four or more courses (2%), or responded "I don't know" (14%). The majority of participants did not have any teaching experience (64%). Ten percent of participants had one year of teaching experience, two to three years of teaching experience (6%), and four or more years of teaching experience (20%). Only 16% of participants reported previously conducting an FA. All participants were required to complete a pre-test on FA knowledge to ensure equivalence on this measure prior to initiating the simulated rehearsal or traditional role play experience. Table 1 shows detailed demographic information on the participants from all three sites including gender, class rank (e.g., junior, senior), program of study, and GPA.

Table 1
Participant Demographics

	Number	%
Gender		
Male	6	7%
Female	77	93%
Class Rank		
Junior	19	23%
Senior	7	8%
Graduate Student	56	67%
Other	1	1%
Program of Study		
General Education	28	34%
Special Education	53	64%
Other	2	2%
GPA		
2.0-2.9	1	1%
3.0-3.9	72	87%
4.0 or higher	10	12%

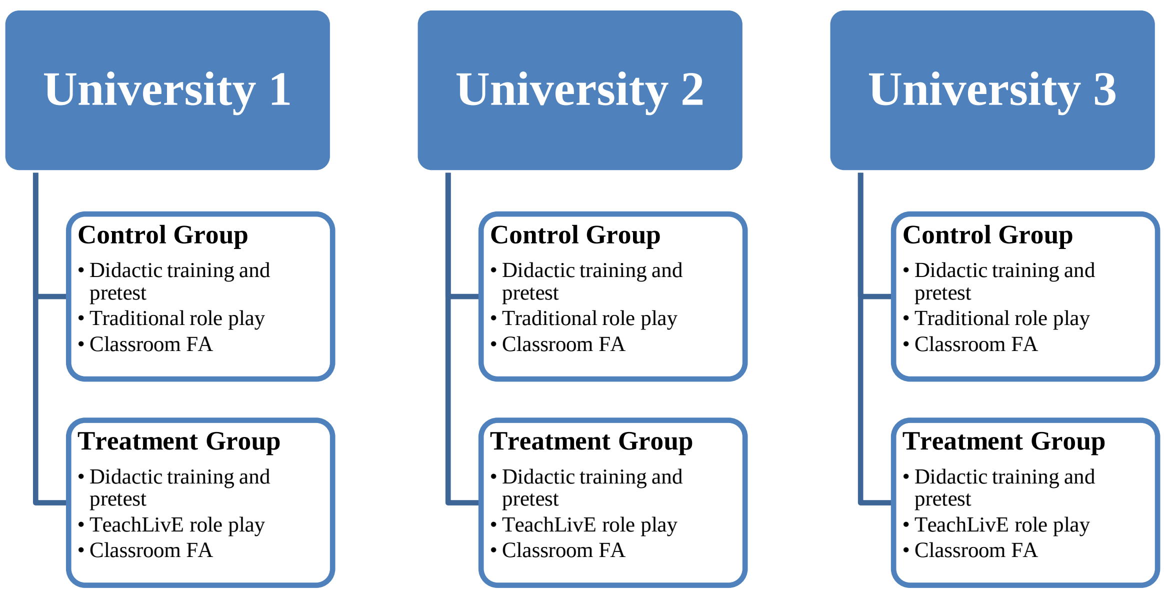
Setting

This study was conducted at three U.S. public universities. University 1 was a large research-intensive Midwestern university, University 2 was a small teaching university in the

Mid-Atlantic, and University 3 was a large research-intensive university in the Southeast. In Universities 1 and 2, coursework in behavior management was delivered face to face, and at University 3, the behavior management course was delivered online through the local learning management system, Canvas®. Approval from Institutional Review Boards was received from respective universities.

Participants were nested within university settings. At University 1, participants in a single course were randomly assigned to the treatment or control group. At University 2, participants were assigned to the treatment or control group by course section. At University 3, participants self-selected into the treatment or control group based on the availability to come to campus and interact in the TeachLivE simulator (see Figure 1). Figure 1 shows the distribution of participants in treatment and control conditions across the three universities.

Figure 1
Overview of Research Design



Face-To-Face Setting

Some traditional role play sessions took place in a face-to-face setting. Face-to-face sessions were scheduled individually with each participant. The sessions took place in an office space, and the researcher provided all materials including a book and colored paper or index cards. On the day of the session, the researcher leading the face-to-face role play session met with the participant and reviewed the session objectives and the operational definition of the target behavior (i.e., tantrumming). Each participant was notified that they would be able to review the steps in each condition prior to their first attempt and they would have two opportunities to implement each condition with feedback in between. The order of the conditions were randomized for each participant.

Skype Setting

Other traditional role play sessions took place via Skype. Skype sessions were scheduled individually with each participant. Prior to the session, the researcher sent an email to each participant confirming the date and time of the session and asking them to come prepared with a book and four common objects (e.g., pencil, paper, apple, ball). On the day of the session, the researcher leading the Skype role play would contact the participant, review the session objectives, and the operational definition of the target behavior (i.e., tantrumming). Each participant was notified that they would be able to review the steps in each condition prior to their first attempt and they would have two opportunities to implement each condition with feedback in between. The order of the conditions was randomized for each participant.

TeachLivE™ Simulator Setting

The version of the TeachLivE™ simulator that was used for this study houses five middle school avatars, including one student with Autism Spectrum Disorder (ASD) who was the focus of the virtual interaction. The student with ASD presented with limited expressive language and behaviors including verbal disruptions (e.g., yelling, crying), physical disruptions (e.g., banging on the table), and stereotypy (e.g., hand movements). The participants in the treatment group came into the lab on the university campus and implemented each condition of the trial-based FA with the avatar with ASD in the context of this virtual classroom environment. On the day of the session, the researcher facilitating the session, reviewed the session objectives, and the operational definition of the target behavior (i.e., tantrumming). Each participant was notified that they would be able to review the steps in each condition prior to their first attempt and they would have two opportunities to implement each condition with feedback in between. The order of the conditions was randomized for each participant.

Classroom Environments

The classroom environment for participants ranged from inclusive to self-contained to 1:1 direct teacher instruction. Participants worked in elementary and secondary classrooms.

Instruction was based upon the student's grade/age level. Some classrooms experienced business as usual interruptions from related services personnel (e.g., occupational therapist, physical therapist, speech and language therapist), co-teachers, or other students.

Research Design

A posttest-only control group design was used for this study. Although participants were not randomly assigned across all three sites, there was a treatment group and control group at each site, and both groups were administered a posttest (Gall et al., 2007). All participants completed the pretest and engaged in a didactic training. The control group then completed a traditional role play experience (face-to-face or via Skype) while the treatment group completed a simulated role play experience in TeachLivE. Then, all participants implemented the FA conditions in an applied setting (i.e., classroom) and were scored on implementation fidelity by members of the research team (see Figure 1).

Scripts used in role play and virtual practice were developed by the first author to provide experience in implementing FA conditions. All three sites employed the same scripts for both conditions and were trained to fidelity by the first author. Due to the nature of the target skill or dependent measure (i.e., FA), it would not have been ethical to conduct an in situ pretest because untrained teachers would have to implement a procedure that was likely to elicit challenging behavior from students with disabilities.

Demographic Survey

Participants completed an online survey conducted using the Qualtrics interface to gather data regarding (a) age, (b) gender, (c) ethnicity, (d), program pathway (e.g., terminal licensure such as special education and grade levels), and € previous instruction or experience with FA content and implementation.

Didactic Training

The didactic training for this study had two components requiring participants to (a) view a pre-recorded web-based training on FA administered by a board-certified behavior analyst (BCBA); and (b) complete and score above 80% on a multiple choice, online assessment on FA procedures. Participants in both the control group and the treatment group participated in this portion of the training.

Test of FA Knowledge. A 20-item assessment was conducted online using the Qualtrics interface to gather data regarding content knowledge of FA measured after the didactic instruction to ensure a baseline level of understanding of FA procedures prior to entering the role play phase of the study. The purpose of this measure was to ensure pre-test equivalence on FA knowledge.

Traditional Role Play

Participants in the control group took part in a role play session either face-to-face or via Skype which gave them the opportunity to practice each of the three FA conditions (i.e., attention, demand, play) with a member of the research team. The face-to-face and Skype sessions were held in a 1:1 setting. During the session, the implementation checklist for each condition was reviewed and each participant was asked to run all three conditions for three mins each. After each condition, the participant was given verbal feedback from a member of the research team on their implementation of the procedure. The feedback provided was linked directly to the rubric for that condition.

TeachLivE™ Role Play

Participants in the treatment group took part in a session in the TeachLivE simulator (see Figure 2) that gave them the opportunity to practice each of the three FA conditions (i.e., attention, demand, play) in the virtual classroom. Figure 2 shows the middle school virtual classroom. For the purposes of this study, the interactor zoomed in on the one student in the front left corner of the classroom. One participant at a time interacted in the simulator. During the session, the implementation checklist for each condition was reviewed and each participant was asked to run all three conditions for three minutes each. After each condition, the participant was given verbal feedback from a member of the research team on their implementation of the procedure. The feedback provided was linked directly to the rubric for that condition.

Figure 2
TeachLive Interface

Classroom-Based Functional Analysis

Each participant was asked to record five-minute samples of each FA condition (i.e., attention, demand, play) with a student in their classroom. The teachers were asked to use their knowledge of the student to determine appropriate instructional activities and reinforcers for each of the conditions.

Interobserver Agreement

All classroom-based FA videos were scored by one observer using the attention, escape/demand, and play rubrics (see Figures 3-5), and 30% of the videos were randomly selected and scored by two observers for the purposes of calculating interobserver agreement (IOA). Each figure outlines the steps for the set-up and implementation of each FA condition as well as an area to score participant performance for their first and second attempt. Interobserver agreement (IOA) was calculated by dividing the number of agreements by the number of agreements plus disagreements and then multiplying by 100. IOA for each FA condition was over 80%.

Data Collection and Analysis

Data was collected on each participant's fidelity of implementation using researcher-designed rubrics, both during the role play and rehearsal attempts, as well as for their classroom-based FA. To compare the impact of traditional role play to simulated rehearsal on mean scores of implementation fidelity to FA procedures, an independent samples t-test was performed on the classroom-based FA data for the two groups.

Measurement of Dependent Variable

Fidelity of implementation was the dependent variable. It was measured using researcher-created rubrics for each of the three FA conditions (i.e., attention, play, and demand) in the classroom setting with a target student (see Figures 3-5). Both video observations (Universities 2 and 3) and direct observations (University 1) were used for the purposes of this study. Direct observation was conducted for participants from University 1 because the local school regulations excluded the use of video of students for any purpose. All video data were scored by study authors. Direct observations were scored by the third author and by doctoral students affiliated with University 1's local center for Positive Behavior Interventions and Supports.

Figure 3
Attention Condition Fidelity Checklist

ATTENTION CONDITION FIDELITY CHECKLIST

Participant Name/Number: ______________________________

Setting (circle one): TeachLivE™/Skype/FTF/classroom

Problem Behavior: ______________________________

Reviewed Steps with Participant Prior to Implementation?: ☐ Yes ☐No

		Attempt 1			Attempt 2		
Segment	Step	Yes	No	N/A	Yes	No	N/A
Set-up	Teacher gives student access to less preferred toys or activities.						
	Teacher sits in a chair and has a book or magazine to "read."						
Implementation	Teacher tells student that they have "work to do."						
	Teacher sits in a chair and pretend to read while student has access to less preferred toys						
	If student plays appropriately – teacher uses planned ignoring.						
	If the student engages in problem behavior – teacher attends with a statement of concern (e.g. "Stop that, you are going to hurt yourself" or "Is everything okay?") within 5 s.						
	If the student engages in problem behavior - After attending, teacher returns to reading.						
	CORRECT STEPS	/			/		
	% OF CORRECT STEPS						

Figure 4
Escape/Demand Condition Fidelity Checklist

ESCAPE/DEMAND CONDITION FIDELITY CHECKLIST

Participant Name/Number: ____________________________________

Setting (circle one): TeachLivE™/Skype /FTF/classroom

Problem Behavior: ____

Reviewed Steps with Participant Prior to Implementation?: ☐ Yes ☐No

		Attempt 1			Attempt 2		
Segment	Step	Yes	No	N/A	Yes	No	N.A
Set-up	Teacher has appropriate instructional materials/tasks ready.						
	Teacher sits across from the student.						
Implementation	Teacher places demand on the student.						
	If the student complies with the demand – teacher provides praise within 5 s.						
	If student complies with the demand – teacher places another demand on student following praise.						
	If the student engages in problem behavior - teacher ~~says~~ "okay, you don't have to work" and remove the demand within 5 s.						
	If the student engages in problem behavior - After 30 s break, teacher presents another demand (score as correct if break is between 25 and 35 s).						
	Teacher ignores non-target problem behavior.						
	Teacher does not allow access to preferred materials.						
	CORRECT STEPS	/			/		
	% OF CORRECT STEPS						

Figure 5

Play Condition Fidelity Checklist

PLAY CONDITION FIDELITY CHECKLIST

Participant Name/Number: ______________________________

Setting (circle one): TeachLivE™/Skype/FTF/classroom

Problem Behavior: ______________________________

Reviewed Steps with Participant Prior to Implementation?: ☐ Yes ☐No

		Attempt 1			Attempt 2		
Segment	Step	Yes	No	N/A	Yes	No	N/A
Set-up	Teacher has preferred items of activities available to the student (e.g. toys, drawing supplies, etc.)						
	Teacher sits in a chair slightly removed from the student and toys/activities.						
Implementation	Teacher does not place any demands on the child.						
	Teacher ignores the problem behavior.						
	If the child tries to interact or play – teacher engages in parallel play						
	If the child is not displaying problem behavior – teacher provides some form of praise every 30 s (score as correct if praise is delivered between 20 and 40 s).						
	CORRECT STEPS	/			/		
	% OF CORRECT STEPS						

Results

To compare the impact of traditional role play and simulated role play on mean scores of implementation fidelity to Functional Analysis procedures, an independent samples t-test was performed. The dependent variable was fidelity of implementation. A description of the statistical analysis and variables under investigation are as follows.

The mean scores on fidelity of implementation for the control group were normally distributed, as assessed by Shapiro Wilk's test ($p > .05$). The mean scores for the treatment group violated the assumption of normality ($p < .05$, $p = .032$). Since the sample size for the groups ($N = 83$) was nearly equal, the independent-samples t-test was run as it is fairly robust to deviations from normality. Levene's test for equality of variances was performed ($p > .05$), indicating the variances are not statistically significant, therefore equal variances are assumed.

There was not a statistically significant difference in didactic instruction combined with rehearsal in a simulated environment ($M = 79.68$) versus didactic instruction combined with traditional role play ($M = 81.26$, $SD = 12.03$) as it relates to fidelity of implementation of FA procedures ($t(42) = -.395$, $p > .05$ = n.s.). Table 2 shows the mean scores on the implementation fidelity rubrics for treatment and control group.

Table 2
Mean Scores Treatment and Control Groups

	Treatment Group	Control Group
Mean	79.68	81.26

Discussion

Students who exhibit challenging behaviors often disrupt the instructional environment, impacting their own learning experience as well as that of their peers (Ling et al., 2011). Given that children who are identified in the first grade as having academic and behavior problems have an increased likelihood of poor academic achievement and dropping out of school by the time they reach twelfth grade (Darney et al., 2013), preparing teachers to identify functions of behavior as the first step in an intervention is a critical skill. Research has documented the benefit of using technology to develop teacher knowledge about behavior management (Hirsch et al., 2015; Kennedy & Thomas, 2012; Kook et al., 2014). More specifically, in conjunction with training on FA, video modeling has been employed with success (Lambert et al., 2013; Lloyd et al., 2014; Moore & Fisher, 2007). The results of this research support earlier findings about the effectiveness of FA training and simulated environments.

The purpose of this study was to evaluate the use of didactic instruction and either simulated rehearsal or traditional role play to train teachers to conduct an FA. This study was an extension of a previous study that explored the impact of simulated rehearsal on the fidelity of implementation of FA procedures within the simulated environment (Vasquez et al., 2017). In the initial study, the researchers found that given an opportunity to implement the procedures in a simulated environment followed by targeted feedback resulted in improved fidelity during the second practice opportunity. The present study compared the impact of simulated role play and traditional role play on fidelity of implementation in an applied environment. The results from this study indicated there was not a significant difference between the fidelity of implementation when trained in the simulated environment versus using traditional role play. However, the results also validate that using virtual environments can be an equally effective tool for preparing educators to implement evidence-based practices when compared to traditional role play experiences. For critics who may be concerned with the real-life application of simulated environments, this study demonstrates that simulated classroom environments, like TeachLivE, are as effective as engaging in traditional role play activities.

Additionally, the benefits of simulated environments are numerous. Most importantly, simulation in virtual environments may provide a safer environment for both participants and children (Vasquez et al., 2017) since challenging behaviors may be evoked during FA trials (Najdowki et al., 2008). Interacting with an avatar versus students in the classroom provides the opportunity to train pre-service and in-service teachers to manage low incidence, high intensity behavioral challenges in a safe environment. This protects children by not accidentally or intentionally evoking behaviors during an FA trial and teachers by not situating them in a condition they may be insufficiently trained to address. A simulated environment also provides opportunities for immediate feedback for a teacher who may need remediation on FA instruction.

The findings from this study also present additional considerations for teacher educators, specifically in the area of teacher retention and attrition. It has been suggested that problematic student behavior impacts perennially high rates of teacher attrition (Oliver & Reschly, 2010) and that first year teachers, in particular, perceive themselves as ineffective managers of this problematic behavior (Smart & Igo, 2010). According to Kirby and Grissmer's (1993) theory on teacher retention, the greater the opportunities to experience actual attributes of a profession, the less likely attrition will occur. However, these opportunities must be deliberate and comprehensive. Therefore, structured instructional and training opportunities may be necessary. Utilizing instruction on FA trials within simulated environments is one way to provide these opportunities for repeated practice. This provides a bridge between coursework and classroom skills with immediate and targeted feedback in a safe "actualized" scenario. As shown in the present study, simulated platforms can yield outcomes that can be positively generalized into real world settings.

Teacher preparation programs may also be challenged to provide sufficient or comprehensive opportunities for FA trial practice. Programs that may not have access to quality practicum experiences may find value in utilizing the simulated or virtual environment. In addition, while a practicum placement may be a quality experience, not all practicums may present students with meaningful behavioral interactions in which teacher candidates can engage with students in a low stakes situation. This may also be a challenge in rural areas where placements are limited. These opportunities could fulfill the need for some practicum experiences in areas where quality or quantity is a challenge. Teacher education may need to evolve and adapt, and TeachLivE is one such way that resources can be allocated (Dieker et al., 2014).

The implications of this study further extend to school settings. Simulated environments could be integrated into a professional learning community (PLC) as a case for discussion or targeted practice. One of the criticisms about researcher-initiated interventions includes the challenge of maintenance after researchers are no longer involved (Rock et al., 2017). To address this criticism, simulated environments could be utilized as a way to revisit or boost fidelity of FA trial training after a lapse in practice or time. While the present study explored generalization to the classroom setting, we did not measure maintenance over time. As proposed by Odom (2009), professional development strategies could be implemented after generalization to reinforce and maintain FA trial practices.

Limitations

The study has several limitations. First, this research included a low number of participants, impacting the generalizability of the results. Second, the participants in this research only engaged in one session with the TeachLivE simulator for approximately 15 minutes. Dieker and colleagues (2014) found that participants who engaged in four 10-minute sessions with virtual rehearsal asked significantly more student directed questions than participants who did not engage in the virtual environments. To optimize transfer of skills from the simulator to the classroom, the number of sessions required should be explored further. Third, differences existed between implementation procedures across settings, which were located across the United States. These differences included face-to-face versus online role plays and video versus direct observation of FA generalization. Further, potentially confounding issues may exist relating to variances in coursework, prior knowledge of participants, and real classroom experiences. While all participants received identical didactic training, coursework across the three universities was not standardized. Therefore, content around behavior management varied widely. Finally, not all students in the classroom engaged in the behavior of concern during the in class trial-based FA. Since the in-class FA sessions were designed to measure FA implementation accuracy, participants were not expected to engage students as they demonstrated targeted challenging behavior. Therefore, not all participants had an opportunity to respond when true target behaviors occurred.

Summary and Next Steps

The fast pace growth of the education technology market shows no signs of deceleration. In 2016, venture-capital funding in educational technology totaled well over $1 billion. The CB Insights (2016) platform, which tracks investments in private companies, puts the number at $1.7 billion. EdSurge, an education-technology reporting website estimates the investment total at $1.6 billion (CB Insights, 2016). Education technology companies are investing enormous capital to modernize education for all students, including students with disabilities. Entirely new education models (e.g., K-12 blended and fully online programs) are currently in development or have been deployed with direct implications for students with disabilities and their teachers. Collectively, these trends suggest technology is a primary component of education for all students, including students with disabilities (Mrstik et al., 2018; U.S. Department of Education, 2016). The transformation from traditional brick-and-mortar classrooms to virtual schools and blended environments at all levels of K-12 education is evidenced by the staggering growth in these environments. Watson and colleagues (2014) suggested every school in the nation has some form of digital learning activity in their district. At least 75% of districts have fully online or blended learning as part of their instructional service delivery model (Freeland & Hernandez, 2014; Straub & Vasquez, 2015; Vasquez & Straub, 2015). The percent of K-12 youth enrolled in online classes or schools increased 300% in the past five years (Rock et al., 2016; 2017; Watson et al., 2014). At that rate, over 50% of all high school classes will be offered online by 2019 (Christensen et al., 2013).

Clearly, technology-rich traditional and K-12 online and blended environments command professionals with skillsets significantly different from those available in current teacher education models (Basham et al., 2013; Vasquez & Slocum, 2012; Vasquez & Straub, 2015). There is clear need to explore how efficacious these innovations impact teachers and students, especially how researchers and instructors try to integrate those innovations in teacher preparation. This study addresses this concern by demonstrating how simulations can be just as effective as face-to-face traditional didactic instruction. In addition, this study presents a new method (simulations) to enhance teacher preparation. As many teacher preparation programs become online programs, this method may be a viable option to enhance the behavior management skills of pre-service and in-service teachers. Future iterations of this study will be to analyze different discrete teaching skills.

References

Aggarwal, R., Ward, J., Balasundaram, I., Sains, P., Athanasiou, T., & Darzi, A. (2007). Proving the effectiveness of virtual reality simulation for training in laparoscopic surgery. *Annals of Surgery, 246*(5), 771-779.

Alexander, J. L., Ayres, K. M., & Smith, K. A. (2015). Training teachers in evidence-based practice for individuals with autism spectrum disorder: A review of the literature. *Teacher Education and Special Education, 38*(1), 13-27.

Austin, J. L., Groves, E. A., Reynish, L. C., Francis, L. L. (2015). Validating trial-based functional analyses in mainstream primary school classrooms. *Journal of Applied Behavior Analysis, 48*, 274-288. https://https://doi.org.org:10.1002/jaba.208

Barnhill, G. P., Sumutka, B., Polloway, E. A., & Lee, E. (2014). Personnel preparation practices in ASD: A follow-up analysis of contemporary practices. *Focus on Autism and Other Developmental Disabilities, 29*(1), 39-49.

Basham, J. D., Smith, S. J., Greer, D. L., & Marino, M. T. (2013). The scaled arrival of K-12 online education: Emerging realities and implications for the future of education. *Journal of Education. 193*(2), 51-60.

Bloom, S. E., Iwata, B. A., Fritz, J. N., Roscoe, E. M., Carreau, A. B. (2011). Classroom application of trial-based functional analysis. *Journal of Applied Behavior Analysis, 44*, 19-31. https://doi.org:10.1901/jaba.2011.44-19

Bloom, S. E., Lambert, J. M., Dayton, E., Samaha, A. L. (2013). Teacher-conducted trial-based functional analyses as the basis for intervention. *Journal of Applied Behavior Analysis, 46*, 208-218. https://doi.org:10.1002/jaba.21

Bransford, J., Lin, X., & Schwartz, D. (2000). Technology, learning, and schools: Comments on articles by Tom Carroll & Gerald Bracey. *Contemporary Issues in Technology and Teacher Education, 1*(1).

Brock, M. E., Huber, H. B., Carter, E. W., Juarez, A. P., & Warren, Z. E. (2014). Statewide assessment of professional development needs related to educating students with autism spectrum disorder. *Focus on Autism and Other Developmental Disabilities*, *29*(2), 67-79.

Brownell, M., Adams, A., Sindelar, P., Waldron, N. L., & Vanhover, S. (2006). Learning from collaboration: The role of teacher qualities. *Exceptional Children, 72*(2), 169-185.

CB Insights. (2016). Retrieved from https://www.cbinsights.com/*Clayton Christensen Institute*. Retrieved from http://www.christenseninstitute.org/wp-content/uploads/2014/06/Schools-and-Software.pdf

Coblentz, C. R. (2017). Effective educational practices regarding general education teachers and inclusion of students with autism. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 78*(6).

Cook, B., Tankersley, M., Cook, L., & Landrum, T. (2008). Evidence-based practices in special education: Some practical considerations. *Intervention in School and Clinic 44*(2), 69-75.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis*. Upper Saddle River, N.J.: Pearson/Merrill-Prentice Hall.

Darney, D., Reinke, W. M., Herman, K. C., Stormont, M., & Ialongo, N. S. (2013). Children with co-occurring academic and behavior problems in first grade: Distal outcomes in twelfth grade. *Journal of School Psychology, 51*(1), 117–128. https://doi.org:10.1016/j.jsp.2012.09.005

Dieker, L.A., Hughes, C., Hynes, M., & Straub, C. (2014). *TeachLivE national research project-year 1 results: Report to the Bill & Melinda Gates Foundation*. Orlando: University of Central Florida.

Dieker, L.A., Rodriquez, 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*, 21-33.

Erbas, D., Tekin-Iftar, E., & Yucesoy, S. (2006). Teaching special education teachers how to conduct functional analysis in natural settings. *Education and Training in Developmental Disabilities, 41*(1), 28-36.

Every Student Succeeds Act, 20 U.S.C. § 6301 *et seq.* (2015).

Freeland, J., & Hernandez, A. (2014). Schools and software: What's now and what's next.

Gable, R., Tonelson, S., Sheth, M., Wilson, C., & Lee Park, K. (2012). Importance, usage, and preparedness to implement evidence-based practices for students with emotional disabilities: A comparison of knowledge and skills of special education and general education teachers. *Education and Treatment of Children 35*(4), 499-520. https://doi.org:10.1353/etc.2012.0030

Gall, M.D., Gall, J.P. and Borg, W.R. (2007). *Educational research an introduction*. (8th ed.). Upper Saddle River, N.J.: Pearson.

Herrmann-Werner, A., Nikendei, C., Keifenheim, K., Bosse, H. M., Lund, F., Wagner, R., … Weyrich, P. (2013). "Best practice" skills lab training vs. a "see one, do one" approach in undergraduate medical education: An RCT on students' long-term ability to perform procedural clinical skills. *PLoS ONE, 8*(9), 1-13. https://doi.org: 10.1371/journal.pone.0076354

Heyvaert, M., Saenen, L., Campbell, J. M., Maes, B., & Onghena, P. (2014). Efficacy of behavioral interventions for reducing problem behavior in persons with autism: An updated quantitative synthesis of single-subject research. *Research in Developmental Disabilities, 35*(10), 2463-2476. https://doi.org:10.1016/j.ridd.2014.06.017

Hirsch, S. E., Kennedy, M. J., Haines, S. J., Thomas, C. N., & Alves, K. A. (2015). Improving pre-service teachers' knowledge and application of functional behavioral assessments using multimedia*. Behavior Disorders, 41*(1), 38-50.

Iwata, B. A., & Dozier, C. L. (2008). Clinical application of functional analysis methodology. *Behavior Analysis in Practice, 1*(1), 3–9. https://doi.org:10.1007/BF03391714

Iwata, B. A., Pace, G. M., Dorsey, M. F., Zarcone, J. R., Vollmer, T. R., Smith, R. G., . . . Willis, K. D. (1994). The functions of self-injurious behavior: An experimental-epidemiological analysis. *Journal of Applied Behavior Analysis, 27*(2), 215-240. https://doi.org:10.1901/jaba.1994.27-215

Iwata, B. A., Wallace, M. D., Kahng, S. W., Lindberg, J. S., Roscoe, E. M., Conners, J., . . . Wordsell, A. S. (2000). Skill acquision in the implementation of functional analysis methodology. *Journal of Applied Behavior Analysis, 33*(2), 181-194.

Jones, P., & West, E. (2009). Teacher Education: Reflections upon teacher education in severe difficulties in the USA: shared concerns about quantity and quality. *British Journal of Special Education*, *36*(2), 69-75.

Joyce, B., & Showers, B. (2002). *Student achievement through staff development* (3rd ed.). Alexandria, VA: ACSD.

Kennedy, M. J., Hirsch, S. E., Rodgers, W. J., Bruce, A., & Lloyd, J. W. (2017). Supporting high school teachers' implementation of evidence-based classroom management practices. *Teaching and Teacher Education, 63*, 47-57.

Kennedy, M. K., & Thomas, C. N. (2012). Effects of content acquisition podcasts to develop pre-service teachers' knowledge of positive behavioral interventions and supports. *Exceptionality, 20*(1), 1-19. https://doi.org:10.1080/09362835.2011.611088

Kirby, S. N., & Grissmer, D. W. (1993). *Teacher attrition: Theory, evidence, and suggested policy options*. Santa Monica, CA: RAND Corporation. Retrieved from https://www.rand.org/pubs/papers/P7827.html

Koch, A., Vasquez, E., Marino, M. T., Straub, C., Schaffer, K., & Donehower, C. (2014). Trial based functional analysis in virtual environments for teacher preparation. Proceedings *TeachLive Conference*. Orlando, FL.

Konrad, M., Helf, S., & Joseph, L. M. (2011). Evidence- based instruction is not enough: Strategies for increasing instructional efficiency*. Intervention in School and Clinic, 47,* 67-74.

Lambert, J. M., Bloom, S. E., Kunnavatana, S. S., Collins, S. D., & Clay, C. J. (2013). Training residential staff and supervisors to conduct trial-based functional analyses. *Journal of Applied Behavior Analysis, 46*, 296-300.

Lambert, J.M., Lloyd, B.P., Staubitz, J.L., Weaver, E. S., & Jennings, C. J. (2014). Effects of an automated training presentation on pre-service behavior analysts' implementation of trial-based functional analysis. *Journal of Behavioral Education, 23*(3), 344-367. https://doi.org:10.1007/s10864-014-9197-5

Ling, S., Hawkins, R. O., & Weber, D. (2011). Effects of a classwide interdependent group contingency designed to improve the behavior of an at-risk student. *Journal of Behavioral Education*, *20*(2), 103-116.

Lloyd, B. P., Weaver, E. S., & Staubitz, J. L. (2017). Classroom-based strategies to incorporate hypothesis testing in functional behavior assessments. *Beyond Behavior, 26*(2), 48-56. https://doi.org:10.1177/1074295617711145

Machalicek, W., O'Reilly, M.F., Rispoli, M., Davis, T., Lang, R., Hetlinger-Franco, J., & Chan, J. (2010). Training teachers to assess the challenging behaviors of student with autism using video tele-conferencing. *Education and Training in Autism and Developmental Disabilities, 45*, 203-215.

Machalicek, W., O'Reilly, M. F., Beretvas, N., Sigafoos, J., Lancioni, G., Sorrells, A., ... & Rispoli, M. (2008). A review of school-based instructional interventions for students with autism spectrum disorders. *Research in Autism Spectrum Disorders, 2*(3), 395-416.

Moore, J. W., & Fisher, W. W. (2007). The effects of videotape modeling on staff acquisition of functional analysis methodology. *Journal of Applied Behavior Analysis, 40*(1), 197–202. https://doi.org:10.1901/jaba.2007.24-06

Moore, J. W., Edwards, R. P., Sterling-Turner, H., Riley, J., DuBard, M., & McGeorge, A. (2002). Teacher acquisition of functional analysis methodology. *Journal of Applied Behavior Analysis, 35*(1), 73-77. https://doi.org:10.1901/jaba.2002.35-73

Mrstik, S., Vasquez, E., & Pearl, C. (2018). The effects of mentor teacher instruction on teaching visual supports to novice secondary teachers in self-contained classes. *International Journal of Instruction, 11*(1), 411-424.

Mueller, M. M., Nkosi, A., & Hine, J. F. (2011). Functional analysis in public schools: a summary of 90 functional analyses. *Journal of Applied Behavior Analysis, 44*(4), 807-818. https://doi.org:10.1901/jaba.2011.44-807

Najdowki, A.C., Wallace, M.D., Ellsworth, C.L., MacAleese, A.N., & Cleveland, J.M. (2008). Functional analyses and treatment of precursor behavior. *Journal of Applied Behavior Analysis, 41*(1), 97-105.

National Academy Press. Retrieved from http://www.nap.edu/openbook.php?isbn=0309072697

National Professional Development Center (2016). http://autismpdc.fpg.unc.edu/evidence-based-practices

National Research Council, (2001). *Educating Children with Autism*. Washington, DC:

Novak, J., Murray, M., Scheuermann, A., & Curran, E. (2009). Enhancing the preparation of special educators through service learning: Evidence from two pre-service courses. *International Journal of Special Education*, *24*(1), 32-44.

Obiakor, F. E., Utley, C. A., Banks, T., & Algozzine, B. (2014). What are emerging trends and future directions in effective inclusive schools for students with high incidence disabilities? *Handbook of Effective Inclusive Schools: Research and Practice* (pp. 474-486). Routledge, NY: Taylor & Francis Group.

Odom, S.L. (2009). The tie that binds: Evidence-based practice, implementation, science, and outcomes for children. *Topics in Early Childhood Special Education, 29*, 53-61. https://doi.org:10.1177.0271121408329171

Oliver, R., & Reschly, D. (2010). Special education teacher preparation in classroom management: Implications for students with emotional and behavioral disorders. *Behavioral Disorders, 35*(3), 188-199.

Palmen, A., Didden, R., & Korzilius, H. (2010). Effectiveness of behavioral skills training on staff performance in a job training setting for high-functioning adolescents with autism spectrum disorders. *Research in Autism Spectrum Disorders*, *4*(4), 731-740.

Pearl, C. E., Vasquez, E., Marino, M. T., Rosenberg, M. Wienke, W. Donehower, C., Gourwitz, J. & Duerr, S. (2017). Establishing content validity of the quality indicators for classrooms serving students with autism spectrum disorder instrument. *Teacher Education and Special Education, 39*(2), 98-120. https://doi.org:10.1177/08884064166814

Pence, S., St. Peter, C., & Giles, A. (2014). Teacher acquisition of functional analysis methods using pyramidal training. *Journal of Behavioral Education, 23*(1), 132-149.

Pennington, B., Pokorski, E.A., Kumm, S., & Sterrett, B.I. (2017). *Practice guide: School-based functional analysis*. Washington, DC: US Department of Education, Office of Special Education Programs.

Reichow, B. (2012). Overview of meta-analyses on early intensive behavioral intervention for young children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *42*(4), 512-520.

Rispoli, M., Neely, L., Healy, O., & Gregori, E. (2016). Training public school special educators to implement two functional analysis models. *Journal of Behavioral Education, 25*, 249-274. https://doi.org:10.1007/s10864-016-9247-2

Rock, M. L., Smith, S., Thomas, C., Regan, K., Vasquez, E., Kennedy, M., Dieker, L., Evmenova, A., Okolo, C., & Bausch, M. (2017). Commentary: A response to an interview with Joseph South by the teacher education and technology and media divisions of the council for exceptional children. *Journal of Special Education Technology, 17*(3), 301-311.

Rock, M., L., Spooner, F., Nagro, S., Vasquez, E., Dunn, C., Leko, M., Luckner, J., Donehower, C., Jones, J. L. (2016). 21st century change drivers: Considerations for constructing transformative models of special education teacher development. *Teacher Education and Special Education, 39*(2), 98-120.

Shy, K., Hageman, J., & Le, J. (2002). The aircraft simulation role in improving flight safety through control room training AIAA modeling and simulation technologies conference and exhibit: American Institute of Aeronautics and Astronautics.

Smart, J. B., & Igo, L. B. (2010). A grounded theory of behavior management strategy selection, implementation, and perceived effectiveness reported by first-year elementary teachers. *The Elementary School Journal, 110*(4), 567-583.

Stahmer, A. C., Rieth, S., Lee, E., Reisinger, E. M., Mandell, D. S., & Connell, J. E. (2015). Training teachers to use evidence-based practices for autism: Examining procedural implementation fidelity. *Psychology in the Schools, 52*(2), 181-195.

Straub, C., & Vasquez, E. (2015). Effects of synchronous online writing instruction for students with learning disabilities. *Journal of Special Education Technology, 30*(4),213-222.

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.

Straub, C., Dieker, L., Hynes, M., & 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. & Ingrahm, K. (Eds.), *Proceedings of 3rd National TLE TeachLivETM Conference 2015: Dissecting Education*, Orlando, FL: University of Central Florida.

Tetzloff, L., & Obiakor, F. E. (2015). James M. Kauffman's ideas about special education: Implications for educating culturally and linguistically diverse students. *International Journal of Special Education, 30*(2), 68-80.

Thomas, C. N., Hassaram, B., Rieth, H. J., Raghavan, N. S., Kinzer, C. K., Mulloy, A. (2012). The integrated curriculum project: Teacher change and student outcomes within a university-school professional development collaboration. *Psychology in the Schools, 49*(5), 444-463.

Thomas, C. N., Smith, C. A., Zhao, X., Kethley, C. I., Rieth, H. J., Swanson, E. A., & Heo, Y. (2012). The efficacy of technology to teach oral reading fluency assessment to pre-service teachers. *Journal of Special Education Technology, 27*(1), 15-32.

U.S. Department of Education, Office of Special Education and Rehabilitative Services, Office of Special Education Programs, (2016). *38th Annual Report to Congress on the Implementation of the Individuals with Disabilities Education Act, 2016*, Washington, D.C. 2016.

Vasquez, E., & Slocum, T. (2012). Evaluation of synchronous online tutoring for students at risk of reading failure. *Exceptional Children, 78*(2), 221-235.

Vasquez, E., & Straub, C. (2015). Online instruction in writing for students with learning disabilities: A review of the literature. *Reading and* Writing Quarterly, 32(1), 81-100.

Vasquez, E., Marino, M. T., Donehower, C., Koch, A. (2017) Trial-based functional analysis in virtual environments. *Rural Special Education Quarterly, 36*(1), 17-24. https://doi.org:10.1177/8756870517703405

Wallace, M. D., Doney, J. K., Mintz-Resudek, C. M., & Tarbox, R. S. (2004). Training educators to implement functional analyses. *Journal of Applied Behavior Analysis, 37*(1), 89–92. https://doi.org:10.1901/jaba.2004.37-89

Watson, J., Pape, L., Murin, A., Gemin, B., & Vashaw, L. (2014). Keeping pace with K-12 digital learning: An annual review of policy and practice. *Evergreen Education Group*. Retrieved from https://eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED558147

Wei, L. S., & Yasin, M. H. M. (2017). Teacher training to increase teacher's competency in teaching autism child. *Journal of ICSAR, 1*(1).