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ABSTRACT

This study investigated the efficacy of two distinct virtual training platforms, TeachLivE™ and Zoom with actors, in preparing preservice practitioners for behavior management in real-world settings. This exploratory study aimed to investigate individual participant skill acquisition and assess which platform better equipped participants with the necessary skills and strategies. This study employed Behavior Skills Training as the foundational pedagogical framework, utilizing structured training and feedback to foster skill acquisition and retention. The two groups, one using TeachLivE™ and the other Zoom with actors, received identical training modules and practice scenarios. After the training, participants were assessed on their ability to apply behavior management strategies in simulated scenarios closely mirroring authentic classroom settings. Results from the study revealed an observable difference in the percent correct performance between the two groups. The TeachLivE™ group exhibited a higher level of success in applying behavior management strategies compared to the Zoom with actors group. This outcome suggests that the immersive nature of TeachLivE™, with its lifelike avatars and interactive virtual classrooms, provided a more effective training environment for preservice practitioners in behavior management.

KEYWORDS

virtual reality, behavior skills training, preservice teachers, classroom management

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*M*any professional fields rely on simulated practice in a variety of formats prior to engaging in actual work. The intent behind such training programs is to step into a profession with the prerequisite, necessary skills and without causing harm to the population served. Pilots fly thousands of miles and spend many hours in simulators; soldiers secure perimeters and engage in combat in virtual and practice environments; firefighters practice in controlled environments, and surgeons use practice labs to simulate surgery. All simulations are typically completed before trainees can practice their profession in real environments with the intended population. Teachers require practice in field-based settings before they interact with students. One way to practice in an environment that can reduce errors or harm to students, either academically or behaviorally through incorrect or inaccurate application of teaching or behavior management practices is through role-play, which has traditionally been conducted during in-person classes. Equally as important, preservice teachers need high-quality feedback on their performance during application in the field that is immediate, corrective, positive, and systematic (Scheeler & Lee, 2002).

Given the ongoing impact of COVID-19, the need for teaching and learning in virtual environments increased (e.g., Stinger Keefe, 2020), thus increasing virtual practice opportunities necessary for teacher candidates. Virtual practice mitigates potential harm to the most vulnerable population of students – students with disabilities with Individualized Education Programs who receive specially designed instruction in the general education and special education classroom. Virtual settings provide teacher candidates opportunities for implementation practice in a non-evaluative setting, reducing the pressure of observations and evaluations. In such settings, they can apply evidence-based practices acquired in university classrooms and apply them with interactive avatars who present challenges akin to those they will experience with actual students in the K-12 setting. The advantages of virtual practice encompass the chance for repeated practice, the absence of negative impacts on actual students, and the ability for university personnel to offer timely and constructive feedback.

Virtual Technology Applications With Teacher Candidates

Virtual technologies uniquely address challenges facing teacher educators (Billingsley et al., 2019). Providing quality opportunities to apply evidence-based strategies learned in the university classroom during field experiences like practicum and student teaching internships is not always feasible, nor is it practical. Student behavior is unpredictable – preservice teachers may not have consistent exposure to high-intensity, low frequency behavior (e.g., physical aggression) or low-intensity, high frequency behavior (e.g., frequent disruptions), which leads to a lack of practice to support adequate mastery in behavior management (Greenberg et al., 2014). Candidates taking online classes and those in remote areas do not always have access to laboratory school settings or classrooms with masterful mentor teachers. Beyond issues of accessibility and the challenge of locating the most qualified cooperating teachers, special educators need to practice applying skills learned in university coursework to address situations that arise during their career (Greenberg et al., 2014). Further, field experiences are often too brief to provide teacher candidates multiple application opportunities and experiences (Swanson, 2023). Simulated experiences allow teacher educators to contrive targeted situations that teacher candidates need but may not have had the chance to encounter in the field.

Additionally, virtual reality experiences can address ethical issues. For example, students with significant support needs require the most qualified, experienced educators. However, special education has high teacher turnover and students with the most educational needs are often served by novice, inexperienced educators (Mamlin, 2012). For those students with higher needs, there is potential for liability when procedures are not performed precisely. For students with challenging behavioral needs, the likelihood of escalating situations is present, and all parties are at risk when untrained individuals attempt to intervene. Escalated behavior can cause injuries, expose teacher candidates to legal consequences, or result in student placement in punitive, more restrictive settings (Kaufmann & Landrum, 2018).

The past decade has seen an increase in special education teacher preparation literature demonstrating the inherent benefits of using immersive and virtual reality to help teachers master pedagogical teaching strategies and behavior management techniques. Virtual reality has been used to help preservice and novice practitioners master the assessment process (Dawson & Lignugaris/Kraft, 2017), conduct difficult Individualized Education Program meetings (Accardo & Xin, 2017), hone behavior management skills (Hudson et al., 2019), and practice delivering academic content (Aguilar & Flores, 2022).

One virtual teaching platform in particular, TeachLivE™ (*see* Dieker et al., 2015; Ersozlu et al., 2021), is used in educator preparation programs across the United States and uses human actors to portray avatar students with specific learner characteristics. This simulation platform provides a safe place for teacher candidates to practice skills, leaves room for error corrections by supervising instructors, and can be recorded to facilitate grading opportunities and feedback when required for classwork. TeachLivE™ provides a space for implementing high-leverage (McLeskey et al., 2022), evidence-based practices learned in the university classroom setting, and for performance feedback on teaching to mastery and removes the potential of harming students or teacher candidates in the process. TeachLivE™ can be intentionally paired with university instruction to bridge the gap between evidence-based practices learned in the university classroom, extends beyond the typical peer-to-peer practice opportunities in the classroom or virtually, and gives students an application opportunity before they work with students in schools.

Behavior Skills Training

Behavior Skills Training (BST; Miltenberger, 2003) is a training framework using instruction, modeling, rehearsal, and feedback, and has been used with teachers, students, school staff, and parents. BST is an effective training procedure to ensure skills are learned and applied, and works to support teacher behavior (e.g., DiGennaro Reed et al., 2010; Ledbetter-Cho et al., 2021). BST uses explicit instruction (e.g., Archer & Hughes, 2011) to combine instruction and practice. The four BST components should be conducted in order and with fidelity. The first component, *instruction*, provides a descriptor of the target skill the teacher is expected to carry out. In the synchronous university classroom, whether in-person or online (i.e., via Zoom), this is facilitated by the instructor. The second component, *modeling*, includes an experienced individual performing (i.e., modeling) the skill in the context in which it is expected to be performed. The model can be live and in-person or recorded on video and shared so participants can access it and use it as a reference. The third component of BST, *rehearsal*, or role-play provides practice performing the skill. Finally, *feedback* is provided as the fourth component of BST, which provides performance feedback to the teacher candidate and allows them to make changes to their future performance, if needed (Elford et al., 2021; Scheeler & Lee, 2002).

Changing and Shaping Student Behavior

Teacher candidates require repeated instruction and practice of skills to promote positive behavioral changes (Colvin, 2004; Kauffman & Landrum, 2018). An educator's first response to inappropriate behavior should be to apply antecedent strategies and provide robust and consistent positive reinforcement for appropriate, expected behavior delivered with fidelity (Scheuermann et al., 2022; Sutherland et al., 2000). Antecedent strategies proactively prevent misbehavior from occurring. Such strategies include positive teacher – student relationships, structure and predictability in terms of instructional organization, clear expectations, and a safe, inclusive classroom climate (Kaufmann & Landrum, 2018; Simonsen, 2008). Additionally, students should receive reminders of appropriate behavior, and feedback on following rules and procedures. Finally, students' behavior is improved when high rates of opportunities to interact and participate in learning through engaging classroom instruction are provided (Simonsen, 2008).

The most effective intervention for increasing desired student behavior (e.g., on-task behavior, task completion, rule-following) is providing consistent, contingent reinforcement for the appropriate expected behavior (Alberto & Troutman, 2021; Cooper et al., 2020). The reinforcement could be specific, contingent praise, prompting, individualized or a group system that targets a particular behavior. For example, if a student is displaying appropriate expected on-task behavior, a teacher should use pivot praise to identify the expected behavior and draw attention to that behavior for students who are not on task. The teacher may say, "Thank you Evan for showing us that you are on task by sitting with your feet on the floor and your eyes on the teacher!"

If antecedent strategies and techniques designed to increase appropriate behavior are ineffective, teachers must have appropriate, effective, and non-punitive responses to address inappropriate or unexpected school behaviors that must be decreased (e.g., disruptive, or disrespectful behavior) or extinguished entirely (e.g., aggression). Simonsen et al. (2008) identified multiple evidence-based behavior management skills designed to decrease inappropriate or unwanted behavior in their repertoire including differential reinforcement, prompting, and restating expectations. Non-punitive, applied behavior techniques designed to decrease or eliminate undesired behaviors are less effective at changing behavior over time than behavior increasers like positive reinforcement (Alberto & Troutman, 2021).

In many classrooms, particularly general education classes, teachers over-utilize behavior reductive techniques (e.g., ignoring, reprimanding, threatening) relying upon them ahead of proactive measures to increase desired behaviors, and sometimes teachers even misuse these practices (Scheuermann et al., 2022). Applying behavior and classroom practices incorrectly can result in continued misbehavior and negative interactions between teachers and students. A cycle of misbehavior typically consists of the use of increasingly restrictive, punitive measures often resulting in removing students from the learning environment. Utilizing evidence-based behavior reduction techniques correctly and ethically in combination with proactive, prosocial responses can result in positive behavior change, keeps students in the learning environment, and fosters positive relationships between teachers, students, and their peers (Jadoon et al., 2022).

Techniques intended to reduce challenging behavior should be administered on a continuum where the least intrusive techniques (e.g., proximity) are used first and more often than techniques that are more restrictive (e.g., reprimanding; Fabelo et al., 2011). Reductive techniques should always be paired with statements that promote positive behaviors (e.g., a teacher telling a student – you're yelling out answers vs. please show respect by waiting to be called on) by

reminding students of the expectations (Simonsen et al., 2008). Behavior reductive practices addressed in this study include natural/benign techniques, cueing/prompting or repeating expectations, (*see* Simonsen, et al., 2008) extinction, pivot praise, or differential reinforcement. Practices were selected for this study (i.e., differential reinforcement, prompting, restating expectations) because they are relatively simple practices that are the least aversive or intrusive but are often underused in favor of more punitive techniques (*see* Jones et al., 2023). When used correctly, they are effective at altering common, undesired student behavior (National Center for Intensive Intervention, n.d.).

Mixed Reality Practice in Behavior Management

A teacher ready to step into the classroom requires subject matter and pedagogical content knowledge and needs to demonstrate this ability through knowledge (i.e., coursework) and application (i.e., fieldwork; Council for Exceptional Children, 2022). Technology in teacher preparation has been used to provide a safe space for university students to apply high leverage (McCleskey et al., 2022) and evidence-based practices (Cook et al., 2009) learned in the university classroom with peers or avatars (i.e., TeachLivE™) without causing harm or practicing incorrectly. The opportunity comes with coaching and feedback from experts (i.e., cooperating teachers and instructors), and teacher candidates can practice in a low-risk environment, minimizing risk for all. Multiple opportunities for practice with the use of technology, including online modules, bug-in-ear coaching (Randolph et al., 2021), and mixed reality simulators (e.g., TeachLivE™) focus on learning and implementing effective teaching practices. Because live practice can be recorded via multiple platforms (e.g., Zoom, Panopto, Yuja), students and instructors can watch and reflect on their videos, using anecdotal and guided video analysis (Nagro et al., 2017) to allow for practice and feedback in a controlled and safe environment.

While some pedagogical skills are best learned and rehearsed in an actual classroom with real students (Phillion et al., 2005), behavioral techniques that address inappropriate behavior are better suited for practice in the virtual environment due to safety and ethical concerns. Colvin (2004) purported that behavioral practice ideally occurs in a controlled setting where carefully constructed opportunities for repetition and reflection are possible. Virtual reality provides a safe space for teacher candidates to learn effective responses to student behavior. The purpose of this study was to investigate the connection of coursework and practice comparing two types of simulated practice (i.e., TeachLivE™ and Zoom with actors) where teacher candidates learned and applied non-punitive responses to inappropriate student behavior. This study sought to answer the following research questions:

1. Which online environment (TeachLive™ or Zoom with Actors) results in higher percentages of correct implementation of behavior reduction techniques learned in a university behavior management class?
2. Is there a difference in accuracy between TeachLivE™ and Zoom with actors when applying behavior reduction techniques learned in a university behavior management class?
3. What perception do students in university behavior management classes have about applying behavior reduction skills in a virtual environment?

Methods

The purpose of this exploratory study was to investigate individual participant skill acquisition and assess which virtual platform better equipped participants with the necessary skills and strategies – TeachLivE™ with avatars or traditional role-play with peer actors conducted via Zoom – for graduate students enrolled in special education behavior management classes across three universities. This exploratory study investigated participants' skills in application of behavior reduction techniques learned in their university-based behavior management class, specifically (a) differential reinforcement, (b) prompting, and (c) restating expectations. The independent variable was the practice method (a) TeachLivE™ with avatars or (b) Zoom with actors. The dependent variable was accuracy of response in the target behavior reduction techniques to address opportunities to respond to challenging behaviors presented in the TeachLivE™ or Zoom environments, and measured by percent correct. The mean performance by group was calculated to shed light on differences in the efficacy of instructional method. Study materials included (a) Canvas, the learning management system across the universities in the study, (b) Canvas module shared via Canvas Commons, (c) Pretest/Posttest survey delivered via Qualtrics, which designs and delivers surveys for academic and commercial purposes, (d) Zoom, which was used for both virtual platforms, TeachLivE™ and Zoom with actors. Demographic information and baseline data were gathered through a 35-item multiple choice pretest survey delivered via Qualtrics. Item number 15 served as the baseline skill measure, where preservice teachers were asked to use a slider to rate their confidence for managing challenging behavior (moderately/highly disruptive behavior, aggression) in the classroom as the teacher of record, with 0 indicating certain failure, and 10 indicating certain success in managing challenging behavior. Participant responses ranged from a low of 2 to a high of 10, with a mean score of 6.25.

Participants

Participants were graduate students at three universities across the United States located in the southeast, central, and southwest. Participants were enrolled in a graduate special education course focused on behavior management at their respective universities. Participants reported a variety of experiences in working with children, including volunteer work, paraprofessional, uncertified teacher, and teaching licensure in such fields as Spanish, Elementary Education, Social Science, Reading, and English as a Second Language. Two participants indicated holding a Special Education endorsement. Participants had a variety of experience with behavior management, which could not be controlled for based on course enrollment. Ten participants indicated some previous coursework or professional development, including single case methods, registered behavioral technician training, and applied behavior analysis coursework. Additionally, participants reported personal and professional experience in working with children who engage in challenging behavior. Fifteen participants reported some classroom experience. Ten participants reported being a parent or family member of a person with a disability. Nine participants reported serving as a nanny, four reported experiences as a camp counselor, and eight reported other types of experiences with children who engage in challenging behavior. The majority reported less than five years of experience. When asked to provide examples of behaviors, participants reported behaviors that included outbursts and non-compliance, but also physical aggression (e.g. hitting, pinching, and self-injurious behaviors). All participants were enrolled in the master's level coursework, and none had taken the course in which they were enrolled. The three participating

courses were selected based on similar behavior management content taught across the universities. Two of the courses were taught asynchronously online, and the third met once a week in person. Students in the courses were seeking a master's degree in special education; one program focused on emotional and behavioral disabilities, one was a verified course sequence in applied behavior analysis, and two of the programs led to special education licensure. Participants' ages ranged from 22 to 61 with a mean age of 31. Between the three classes, 38% of students (n = 26) agreed to participate at the beginning of the study. However, with attrition, ~30% of students (n = 20) ultimately participated in the study. Participants self-reported demographics, which is shown in Table 1.

Table 1. Participant Characteristics

	TeachLivE™	Zoom with Actors
Gender		
Female	8	10
Male	2	0
Race		
White	6	6
Black	1	1
Hispanic	2	2
Asian	1	1
Other		1

Setting

Although the study was voluntary, as part of the course curriculum, students in all three classes completed the same learning module asynchronously prior to engaging in the study. The study was conducted virtually with all participants. For study integrity, the modules and activities associated with the study were presented asynchronously in an online module via a common Canvas (the Learning Management System used at all three universities) module for all students, including those in the in-person course section. Once the students completed the online module in their respective course, they completed a Qualtrics survey to opt in or out of the study.

Procedures

The lead university received institutional review board approval (IRB), then the second and third universities received reciprocal approval using the first university's IRB protocol.

Learning Module

All students in the classes regardless of study participation status were required to complete a Behavior Change Techniques module in Canvas the same week to learn about evidence-based behavior reductive techniques. The module was collaboratively created by the first and second authors, shared via Canvas Commons, then imported into individual course shells. The module used the 5E model (Bybee, 2009) for lesson planning. The first section of the module, *Engage*,

was an introduction video orienting students to the module and a downloadable workbook of guided notes to be completed as students read through material and watched assigned videos. The *Explore* section consisted of readings, videos, and guided notes to accompany the readings and videos on reducing challenging behaviors. Students watched several videos, including an overview with an introduction, and select content from two online modules: Behavior Course: Module 5 from the National Center on Intensive Intervention (n.d.), the IRIS Center module Addressing Challenging Behaviors (Part 2 Elementary): Behavioral Strategies (IRIS, 2022), and two reading assignments: Ayres et al. (2019) and Mayer et al. (2019). Students uploaded their guided notes in the *Evaluate* section for a grade. The *Engage*, and *Explore* sections provided students with knowledge of behavior reductive strategies. *Evaluate* provided students with a short quiz for accountability.

Independent Variable – Simulation Activity

Once complete, all students in three courses across the universities, including non-participants in the study, accessed the Project – Simulation Activity section of the module. An overview video of the simulation activity expectations was provided for students. Next, students were given a copy of an explicit instruction math lesson plan along with a video example of the lesson being presented by the first author without student misbehavior. The lesson plan focused on adding positive and negative integers, a lesson appropriate for 6^{th} or 7^{th} grade students in a special education math class. The lesson presented three methods to add integers: 1) using a number line; 2) using counting chips; and 3) using a song as a mnemonic device, one of which participants would employ during the virtual session. Study participants then scheduled their sessions using a signup website, and non-participants were required to submit a video of their lesson.

For the simulation activity, students were required to teach the Guided Practice part of the lesson plan. To provide an example of the lesson students were expected to teach, the first author professionally recorded two videos teaching the required section with voiceover explanations, one with the entire math lesson, and one with simulated student misbehavior. Information and code words were embedded in this video, which was accompanied by a 5-question quiz on the video model for accountability to ensure students watched the videos. Students were asked to identify the information embedded in the video to get full credit on the quiz. Once all students completed the virtual session (required of participants) or recorded and uploaded their videos (required of non-participants), the posttest was shared with all students. All virtual sessions were recorded to the first author's university cloud via Zoom and shared using Yuja, an internal video platform, where the researchers were able to view the videos securely with a unique link for each video.

Data Collection and Analysis

Data Collection

Pretest survey was administered prior to the study to obtain a baseline level of behavior management knowledge and gather informed consent. Posttest surveys were administered to measure growth in behavior management knowledge and social validity. Participant sessions were recorded on Zoom by the session facilitator then shared via Yuja using individual links with participant numbers assigned and identifying information removed.

Table 2. Behavior Reduction Coding Definitions with Examples

Behavior Reduction Technique	Operational Definition and Example Statement
Correct Behavior Reductive Techniques - Coded as Correct on Data Sheet	
Differential Reinforcement	Reinforcing one aspect of a behavior that is expected/appropriate with the intent of reducing unexpected behaviors. **Example statement:** I really appreciate how eager you are to participate, but let's give our classmates a chance to participate.
Prompt	Cue student, engage, error correction; includes reminder of behavior **Example statement:** let's pick up our head and answer this question together.
Restating expectations	Reiterating classroom expectations to student verbally; Includes redirection to task **Example statement:** remember we need to raise our hand to be called on.
Natural, benign	Humor, proximity control, offer academic supports, cease instruction, and wait for behavior to correct **Example statement:** Let me help you answer that math problem.
Pivot Praise	Remark on a different student's expected behavior to prompt a student who is not meeting expectations to change their behavior **Example statement:** Thank you, Yolanda, for appropriately raising your hand and waiting to be called on!
Incorrect Behavior Reductive Techniques - Coded as Incorrect on Data Sheet	
Ignore	No response or acknowledgement of the disruptive behavior from the teacher. **Example:** Teacher does not acknowledge the student's response and continues to teach the lesson.
Threaten	Teacher responds to student behavior with a threat, cajole, or promise of negative consequences. **Example statement:** Bobby, if you do that again, you will go to the office.
Reprimand	Teacher expresses verbal disapproval of the student's actions. **Example statement:** Antwon you shouldn't be talking while I'm teaching, that's not ok, and unacceptable behavior.

Note: Adapted from Scheuermann et al. (2022).

Data Analysis

Data from the pretest and posttest surveys were analyzed by item. The first author reviewed and coded all videos. Participants were expected to apply the behavior reductive techniques they had been taught during the Behavior Skills Training sequence. Participant data videos were coded based on a data sheet created using the script. Correct behavior reductive techniques were defined with examples of each, which were included on the data collection sheet. See Table 2 for operational definitions of these practices and examples for both correct and incorrect behavior reductive techniques. After identifying which technique the participant used to address inappropriate behavior during the simulation groups and coding responses as correct or incorrect,

percent correct was calculated where the number of correct responses was divided by the total number of opportunities provided to the participant to establish a rate of correct responses. The mean for correct responses was then found for each condition to determine which online environment resulted in higher rates of correctly applying behavior reduction techniques learned in a university behavior management class. Further, data were analyzed for patterns of variability by counting the total number of opportunities to respond to inappropriate behaviors using behavior reductive techniques across both online environments to determine which condition invited more variability. Last, because student perception has a profound impact on whether teacher candidates will continue to use techniques learned once they have their own classrooms, results on a social validity survey were averaged and reported.

Figure 1. Data Sheet/Script Example

Challenging Behavior Opportunity	**Opportunity**	**Correct Response Techniques used to decrease behavior**	**Incorrect Response**
Teacher: We will now begin practicing what we learned about adding positive and negative numbers. I will write a problem on the board and choose someone to solve it. You can solve one of three ways: You can use the number line, you can use the song, or you can use the counting chips. I want you to agree to try your best. This is the part of the lesson where we work together. Sean: [*blurts out before teacher chooses a student*] I want to use the counting chips!			
1. I want to use the counting chips!	Opportunity 1	☐ Differential Reinforcement ☐ Prompt ☐ Restating expectations ☐ Natural, benign ☐ Pivot Praise	☐ Ignore ☐ Threaten ☐ Reprimand
Teacher: [*choose Sean*] Sean, let's work a problem together! Sean, which method would you like to use to solve -5+4? Sean: Duh, the chips. I just said that. And you say *I* don't listen to *you.*			
2. Duh, the chips. I just said that.	Opportunity 2	☐ Differential Reinforcement ☐ Prompt ☐ Restating expectations ☐ Natural, benign ☐ Pivot Praise	☐ Ignore ☐ Threaten ☐ Reprimand

Figure 1 provides an example of the data collection sheet, which included a portion of the script with embedded opportunities for participants to apply behavior reductive techniques. Depending on the participant's response, the opportunity was coded as correct or incorrect, and the coder checked the box to identify the type of correct or incorrect response. For example, when the participant reached the first opportunity to address Sean's blurting out behavior (see number 1 of Figure 1), the response or technique provided by the participant was noted and counted as correct or incorrect by checking the corresponding box.

Behavior reductive techniques marked as *correct* include Differential Reinforcement (e.g. "Sean, you are doing great staying engaged in the lesson"), Prompt (e.g. "Remember to wait until it is your turn, Sean"), Restating expectations (e.g. "Respectful behavior would look like waiting

until it's your turn to talk"), Natural, benign (e.g. Teacher puts their finger to their lips), or Pivot Praise (e.g. "Eddie, you are doing a great job listening quietly"). Opportunities to apply behavior reductive techniques varied by group. Both groups of simulated students were asked to perform approximately ten misbehaviors during the lesson. In the Zoom with actor group, participants received between 6 and 13 opportunities to apply behavior reductive techniques. In the TeachLivE™ simulation group, participants were provided between 7 and 10 opportunities to apply behavior reductive techniques. Differences depended on natural responses based on how the participant responded. For example, if an actor blurted out but the participant (teacher) didn't hear, the actor may repeat the behavior but say it louder than necessary resulting in yet another opportunity for the participant to respond.

Interobserver agreement and procedural fidelity

Interobserver agreement (IOA) was completed by the second author after all videos were coded by the first author. The second author coded 6 videos out of the total 20 for IOA; 30% of the videos in each group were coded for IOA. Coders compared results for consistency and established 100% IOA between coders. Procedural fidelity was measured using a checklist based on the recorded sessions and videos reviewed. This included the following items: Zoom recording started, session facilitator read script and explained time limit, and lesson no more than 10 minutes. Procedural fidelity was 100% across all sessions where interobserver agreement was conducted.

Social validity

Participants were given a 10 question social validity survey once they completed the virtual session. The survey sought to identify their perceptions on format, use of instructional time, if the format worked for them, and if they thought teachers would find virtual practice useful. Participants were also asked if they would suggest this type of virtual role-play to other teacher education students, if they could choose one type of role-play over another, if they were confident in their entry-level knowledge and skills for implementing behavior reductive techniques, and if the format of instruction was an effective way for them to learn new content. Finally, the social validity survey asked participants to rate their confidence for managing challenging behavior (i.e., moderately/highly disruptive behavior, aggression) in the classroom as the teacher of record using a slider from 0 to 100. The more confident a teacher candidate feels in using evidence-based techniques, the more likely they are to retain and use the skills in their future classes.

Results

Results are reported for pre- and post-test survey, for the intervention, organized by research question, and for social validity. Pretest survey items gathering information on demographics, relevant teaching experience, and baseline self-report for behavior management have been reported above in methods and procedures.

Accuracy of Implementation

The first research question explored the implementation rate of behavior reduction by students in a behavior management class using two online platforms. Participants applied the skills learned during the virtual sessions in their assigned group. The TeachLivE™ group applied the behavior

Table 2. Percent Correct and Number of Opportunities to Reduce Challenging Behavior Across Groups

	% of correctly reduced behavior	# of opportunities to correctly reduce challenging behavior		% of correctly reduced behavior	# of opportunities to correctly reduce challenging behavior
TL1	86%	7	Z1	83%	6
TL2	57%	7	Z2	55%	11
TL3	78%	9	Z3	45%	11
TL4	78%	9	Z4	54%	13
TL5	78%	9	Z5	62%	13
TL6	89%	9	Z6	100%	9
TL7	50%	10	Z7	77%	13
TL8	89%	9	Z8	90%	10
TL9	88%	8	Z9	85%	13
TL10	63%	8	Z10	17%	6
Mean	76%	8.5	*Mean*	67%	10.5

Note: TL – TeachLivE™; Z – Zoom with Actors

reductive techniques with more accuracy as measured by percent of correct opportunities than the Zoom with actors group. The TeachLivE™ group application scores ranged from 50-89%, with a mean of 76%. The Zoom with actors group scores ranged from 17-100% and a mean of 67%. Another way to look at this data is by considering levels of skill mastery. In education, including teacher education, a frequently accepted standard is that 80% accuracy for a newly developing skill is sufficient (Apkan, 2020; Bloom, 1968). Further, in teacher training for behavior management, percent correct is historically a commonly used metric (e.g. Moore, et al., 2002; O'Reilly et al., 1994). In this case, examination for mastery of the Zoom group would show that 40% of participants achieved mastery of 80% or above (range, 83.33-100%), only one participant approached mastery (76.92%), and the remaining 50% of participants in the Zoom group were unable to perform the skills adequately, with scores ranging from 61.54% to a low of 16% accurate

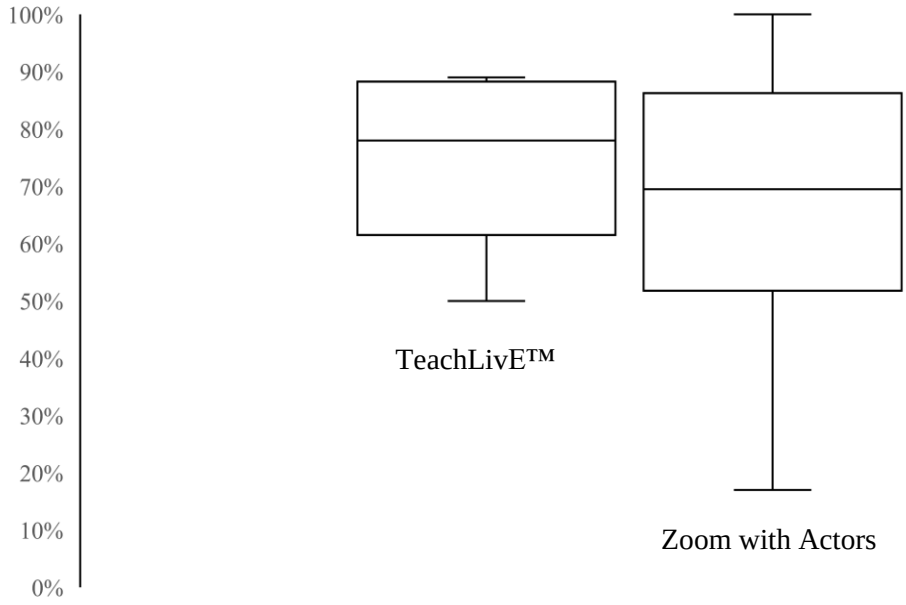
responses. In the TeachLivE™ group, participants as noted were observably more accurate overall, but the method was also effective for bringing more students toward mastery. In the TeachLivE™ group, equivalent to the Zoom group, 40% of participants achieved sufficient mastery for a newly developing skill (range, 85.71-88.89%), another 30% of participants approximated mastery (77.78%), and the 30% of lowest performers in the TeachLivE™ group had a range of 50-62.5% accuracy. Table 2 provides data for percentage of opportunities to correctly reduce behavior across participants along with detail for the number of opportunities to apply behavior reductive techniques across groups. for both participant groups.

Opportunities to Respond

The second research question sought to identify if variation occurred in the behavior reduction application between platforms. Participants in the Zoom with actors group were provided more variability in the number of opportunities, with a range of 6-13, and a mean of 10.5. Participants in the TeachLivE™ group were given between 7-10 opportunities to reduce behavior, with a mean of 8.5. Table 2 also provides the detail for the number of opportunities to apply behavior reductive techniques across groups. Results are also listed in Figure 2, which provides a graphic display of the data showing opportunities where participants appropriately applied behavior reductive strategies.

The pretest and posttest asked participants to rate their confidence managing challenging behaviors in the classroom on a scale of zero to 10 (i.e., 0 indicating certain failure, and 10 indicating success). Pretest data showed that participant responses ranged from a low of 2 to a high of 10, with a mean score of 6.25. Posttest data showed participant responses ranged from a low of 3 to a high of 10, with a mean score of 7.8. See table 3 for a comparison of participant pretest and posttest scores by group.

Figure 2. Graphic Display of Participant Results



Social Validity Results

The third research question addressed student perception of learning and applying behavior reductive skills in a virtual environment. This was answered using a social validity questionnaire, where participants indicated their agreement or disagreement with the statements. When asked about the instructional format, 94% of participants agreed that it worked well for them. Participants overwhelmingly believed (94%) the instructional format was an optimal use of instructional time. Only 57% of participants agreed that teachers would find the activity appropriate for learning the content. Additionally, 94% of participants would suggest this use of instruction to other students in similar courses. If given an option, 21% of participants would have chosen role-play to learn content during coursework over virtual reality, while 26% of participants indicated they would have chosen virtual reality over role-play. All participants (100%) felt confident in their entry-level knowledge and skills for implementing behavior reductive techniques, and they found the instructional format an effective way to learn new content. Given the opportunity to rate their confidence in managing challenging behaviors on a scale of 0 to 100, participants rated themselves an average of 75% with a range of 18-95%.

Table 3. Comparison of Self-Rated Confidence to Manage Challenging Behaviors by Group

	Pretest	Posttest		Pretest	Posttest
TL1	6	8	Z1	6	DNC
TL2	5	8	Z2	6	9
TL3	10	9	Z3	4	7
TL4	6	9	Z4	8	2
TL5	2	6	Z5	4	DNC
TL6	3	9	Z6	3	9
TL7	8	9	Z7	8	3
TL8	9	9	Z8	7	8
TL9	7	DNC	Z9	6	8
TL10	8	10	Z10	5	9
Mean	6.4	8.6	*Mean*	5.7	6.9

Note: TL – TeachLivE™; Z – Zoom with Actors; DNC – did not complete.

Discussion

Regardless of the type of virtual environment, having the opportunity to practice behavior techniques prior to teacher candidates being placed with actual students addresses the challenges mentioned earlier. Teacher candidates need the opportunity for repeated practice to achieve mastery with evidence-based practices that address inappropriate student behavior. The risk of employing ineffective techniques or using them incorrectly can have dire outcomes for the teacher and the student.

Results of this study indicate that participants were able to apply behavior reductive techniques more effectively with TeachLivE™ avatars than with live actors role-playing in the Zoom group, addressing the first research question. The 9 point percentage difference in mean between the groups is notable and shows that students in the TeachLivE™ group were able to apply the strategies learned during the online learning module within the virtual reality environment slightly better than those who used Zoom with actors. In a virtual reality setting, instructors contrive a script with specific benchmarks embedded to assess application of behaviors or skills learned in the classroom. In this case, trained actors playing the avatars who are experienced in modeling characteristics of children's behaviors in TeachLivE™ more closely adhered to the script than live actors, who were graduate research assistants, and this variability was demonstrated in the number of opportunities to apply behavior reductive techniques. Also, teacher educators cannot effectively program the content of the learning environment, whereby they have less control when using human actors or role-players. This was evidenced in the Zoom environment where actors failed to closely adhere to the script, resulting in the variability of opportunities to respond, and often included unexpected comments. Some may theorize that because student behavior in a real classroom is unscripted and unpredicted that this model would be desirable. However, teacher educators carefully scaffold learning opportunities for their students. The BST framework promotes such presentation of content, modeling, rehearsal, and feedback in a repeatable pattern. Teacher educators must provide learning content in a systematic manner and provide practice opportunities in a safe, controlled manner such as that offered via virtual reality.

To increase the generalizability of this study, additional work should focus on ensuring multiple opportunities for students to rehearse teaching the math lesson without misbehaviors and the opportunity to practice the script with peers prior to practicing their behavior reduction skills in the virtual environment to reduce anxiety when performing. In this way, researchers could be more assured that they were measuring only participants' ability to use behavior reduction skills without other confounding variables. Several of the student participants indicated they were nervous due to never previously having taught a lesson at all; this also possibly deterred students from participating in the study.

Limitations

As is often the case with applied research, several limitations affected the generalizability of this research. The most significant impact to the study was the decrease in posttest scores over pretest scores. Only 85% of study participants took the posttest and of those that did, only one showed a higher score than the pretest. Further, only 19 out of 20 participants completed the social validity survey. While we cannot know for certain what caused this phenomenon, we speculate that some of the students may have skipped questions impacting the decision tree in the survey, or students

dropped the class after their simulation was complete and did not complete the requisite surveys. Further, it is possible that participants overestimated their confidence, knowledge, and skills at pretest, and that the opportunity for practice via Zoom or TeachLive™ helped them to have a more realistic viewpoint about behavior management (Vidal, 2023).

The simulation activity schedule changed multiple times due to circumstances beyond our control which created student confusion and frustration. It appears likely that students took the posttest without much fidelity due to the number of students whose scores were so much lower than their baseline measure. Additionally, the pretest was administered early in the semester before students had other course responsibilities. The posttest, on the other hand, was administered at the end of the course, around the same time as final exams and final projects; therefore, it is possible that students became overwhelmed with end-of-course responsibilities. Students had been assured that grades related to the study would not connect to their overall course grade. This may have been an activity they felt that mere participation was worth more than performance.

Additionally, future studies should seek to include more participants to enable further statistical analysis of data. In this study, while it might be possible to analyze group comparisons for statistical and practical significance, in combination with the small sample, the variability in the comparison group for both the number of data points in opportunities to respond, along with the variability of percent correct introduce error and violate assumptions which would not provide confidence in results. For real teachers in their real future classrooms, understanding their rate of mastery by observing how many times they were able to respond correctly when presented with an opportunity to apply a behavior reductive technique is meaningful.

Conclusion

While the purpose of this exploratory study was to determine if there were differences in application of behavior reductive techniques in virtual environments, participants found value in practicing the skills learned in the university classroom. Students do not often get to practice the behavior management skills and strategies they learn with K-12 students because of potential psychological and physical harm. Virtual environments provide a safe space for students to practice behavior reductive techniques with no indication of harm, especially with the most vulnerable populations, including those with disabilities. Consistent with the findings of Peterson-Ahmad (2018), virtual environments allow for repeated practice opportunities and feedback. These findings highlight the potential of advanced virtual simulations, like TeachLivE™, as a valuable tool for preparing future practitioners in behavior management. The study's implications are significant for educators and training programs seeking innovative methods to enhance the skills and competence of preservice practitioners in a realistic and controlled virtual environment. This is invaluable and necessary before teacher candidates enter the field.

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