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Developing Active Listening in CSD Undergraduates: A Pilot Comparison of Computer-Based Simulations and Immersive Virtual Reality

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Developing Active Listening in CSD Undergraduates: A Pilot Comparison of Computer-Based Simulations and Immersive Virtual Reality

Abstract

Simulated learning experiences (SLEs) are becoming increasingly popular in communication sciences and disorders (CSD) training programs. This pilot study examines the relative effectiveness of delivering a SLE via standard computer or using virtual reality headsets for a more immersive learning experience. Seventy undergraduate CSD students were randomly assigned to complete the same SLE using one of these two modes of delivery to explore the technology's effect on learning outcomes and self-confidence. Although no statistically significant difference in outcomes was observed, medium effects of intervention were observed on all outcomes, suggesting further is research is needed into the impact different technologies can have on student learning associated with SLEs.

Keywords

Simulation; Virtual Reality; Undergraduate; SLE

Authors

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Introduction

Effective communication is a critical professional skill in allied health fields such as speech-language pathology and audiology, with the American Speech-Language-Hearing Association requiring pre-service training programs to demonstrate how their graduates communicate effectively with patients, families, and other professionals (ASHA, 2018). One component of effective communication is active listening, which has been defined as "an attempt to demonstrate unconditional acceptance and unbiased reflection by a therapist of a client's experience" (Weger et al., 2010). Active listening includes nonverbal communication that indicates listener engagement in the interaction, paraphrasing the speaker's message to attempt at understanding their intent, and asking questions that enable the speaker to elaborate further as necessary (Thistle & McNaughton, 2015). Speech-language pathologists and audiologists must utilize active listening as they work with people who have communication disorders, their families and caregivers, and collaborate with other professionals to maintain high standards of care. Further, active listening plays a role in how people perceive healthcare providers (Kagan, 2008) and influence the quality of healthcare outcomes (Street et al., 2009), suggesting that pre-service training programs in communication sciences and disorders (CSD) should strongly consider how they are supporting students' development of these skills. One potential approach to supporting students' developing active listening skills is to implement simulated learning experiences to maximize student learning outcomes and self-confidence as applied to pre-clinical (or clinical) critical thinking.

Theoretical Frameworks and Application. Identifying effective instructional methodologies for students in CSD requires academic and clinical educators to understand theoretical perspectives on how learning occurs. Constructivist approaches to learning suggest that people build knowledge through experience and subsequent reflection, which emphasizes the importance of students' active involvement and engagement in the learning process. Experiential learning theories such as those proposed by Kolb (1984) and Jarvis (1987) specifically emphasize the importance of reflecting on and responding to potential learning experiences and have been used previously in the field of CSD as a model for understanding and supporting students' development (Walden & Gordon-Pershey, 2013; Rehfeld et al., 2022).

Academic and clinical educators in CSD must consider how best to provide opportunities for students to acquire active listening skills in a way that provides meaningful practice opportunities with feedback (Thistle & McNaughton, 2015; Mandak et al., 2020). One option is training supervised by faculty, which is resource intensive given the student-faculty ratios often seen in higher education. Vostal and colleagues (2022) reported on the use of graduate assistants following scripts as communication partners for undergraduate students recently trained on active listening skills while Mandak and colleagues (2020) developed online modules to address similar skills and measured students' use of during simulated interactions with parents of children with complex communication needs. These examples relied on simulated learning experiences (SLEs) that use standardized patients, or people trained to fill a specific role, to facilitate students' ability to practice active listening. A potential downside to the in vivo use of standardized patients is that it requires human capital to which academic and clinical educators may not have consistent access.

Simulations and Their Role in CSD Education. To increase the number and flexibility of learning opportunities available to students, many CSD programs are turning to the use of simulations, including standardized patients, to more actively involve students in the learning process (Dudding & Nottingham, 2018). SLEs can take a wide range of forms and have been defined as "a technique—not a technology—to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner" (Gaba, 2004, p. i2). These simulations can be helpful in providing students with low-stakes opportunities to practice the skills needed to work with high-risk populations such as pre-term infants (Ferguson & Estis, 2018), engage in family-centered planning with caregivers of those with complex communication needs (Mandak et al., 2020), or even implement appropriate intervention strategies with children who stutter (Meyers et al., 1989). Simulations can also increase students' perception of psychological safety, or their belief that mistakes will not result in judgment, which is helpful to the learning process (Clinard & Dudding, 2019; Nembhard & Edmonson, 2012).

Although Gaba (2004) defines simulation as a technique rather than a technology, it is important for academic and clinical educators to consider the technologies that are used to deliver SLEs. In a national survey of CSD programs, Dudding and Nottingham (2018) summarized five different types of simulation reported by the Society for Simulation in Healthcare (2016), including standardized patients, task trainers, mannequins, computer-based simulations, and virtual reality (VR). These types of simulation can be delivered using a range of different technologies, including no technology, standard technology such as desktop computers, or more advanced technology such as VR headsets. As advanced technologies become more readily available, the ability to deliver more immersive SLEs increases. Increasing the immersive nature of SLEs should facilitate transfer of learned skills between the simulation and reality by increasing the similarity between the instructional setting (i.e., the simulation) and the generalization setting (i.e., work environments) (Cooper et al., 2020). Immersive SLEs also promote learning through direct experience, which is consistent with Kolb's (1984) experiential learning theory and a constructivist approach to learning through active engagement.

Dudding and Nottingham's (2018) survey found that many CSD programs are incorporating standardized patients and computer-based simulations into their curricula. Technologies used to deliver these simulations are constantly evolving, therefore, ongoing research is necessary to determine how and when to integrate these advances into pre-service training curricula and at what level(s). Of the types of simulation mentioned above, computer-based simulations are currently popular with CSD programs, likely due to their reduced need for resources compared to standardized patients, mannequins, and VR simulations that require training and/or specialized equipment. As mentioned above, the in vivo use of standardized patients requires consistent access to humans willing to and capable of filling pre-defined roles while the use of high-fidelity mannequins requires a significant financial investment in tools with potentially limited applications, such as simulating infant feeding (Ewing, 2015).

Previous work on the use of SLEs in CSD has found positive effects of instruction on student learning even as technology itself has changed. For example, a 1989 study conducted by Meyers and colleagues examined how graduate students responded to a simulated child who stutters by interacting with a microcomputer. Participants who completed the SLE increased their use of effective strategies and decreased their use of ineffective strategies with real children who stutter more than their peers who did not complete the simulation. Although technology and the concept of SLEs have both come a long way since the 1980s, positive effects continue to be reported related to SLEs. In a study reported by Carter (2019), graduate students completed a paper-based case study or a computer-based simulation during a course on language disorders. Students who completed the computer-based simulation outperformed their peers on several key clinical metrics, including their skills related to assessment, diagnosis, and recommendations as well as their overall critical thinking ability. These examples suggest that SLEs can be a valuable instructional approach to developing CSD students' knowledge and skills.

Considerations When Using More Immersive Technologies to Deliver SLEs. Although SLEs can be beneficial, the technology used to deliver them can have unintended consequences that may affect student learning. For example, Ewing (2015) reported that students who completed live simulation training with a high-fidelity mannequin simulating an infant in distress reported significantly higher levels of stress compared to their peers who completed the same simulation using videos. Ewing acknowledged that various levels of student stress during the simulation depending on the group they were assigned (i.e., live with a mannequin or watching videos of someone else handling the same mannequin) may have influenced differences between the groups on outcome measures. Similarly, Kelly and colleagues (2023) reported that students responded favorably overall to a VR simulation experience related to administering an oral mechanism exam. However, one student reported an adverse reaction to using the headset technology required for immersion, saying "Hopefully we won't need to use it again because it made me feel ill." (p. 6). Despite the potential benefits associated with more immersive SLEs, academic and clinical faculty in CSD must consider the potential for adverse effects when considering integration of new technologies for instruction.

Fully immersive simulations (i.e., those using VR) such as the one reported by Kelly and colleagues (2023) can better center students' awareness on the salient context of the simulation itself by removing the visual reminders that they are in a classroom or similar space. These VR simulations are delivered using headsets such as the Meta Quest 2 (Meta, 2020), which increases their cost compared to computer-based simulations that can be navigated on a standard desktop or laptop. In contrast to the purchase of high-fidelity mannequins, however, VR headsets have the potential for a variety of applications in CSD programs similar to when programs purchase standard computers for language sampling or speech analysis software. To date, however, there is minimal research into the utility of such VR applications in CSD beyond the study by Kelly and colleagues (2023) mentioned above, and even less research comparing the effect of the same simulation delivered via fully immersive technology versus a standard computer.

Studies specific to VR technology provide insight into its general effectiveness (Coban et al., 2022; Merchant et al., 2014). Merchant and colleagues reported a small effect of $g = .41$ while Coban and colleagues found a similarly small effect size of $g = .38$. These findings suggest that the increase in costs associated with the hardware needed may not result in significantly improved learning outcomes. Although the effect, on average, is positive, the variability in potential outcomes and lack of studies in CSD included in these reviews should give programs pause before heavily investing in new technologies.

Research Gap. Previous research in CSD has not substantially examined the utility of immersion technologies in facilitating the learning of new concepts and skills. With many universities pushing for innovation and the incorporation of new technologies to support students' learning, it is imperative that programs make informed decisions about new adoptions. This challenge becomes even more difficult when considering the interaction between simulation type (e.g., standardized patient role plays, working with mannequins, or responding to recorded videos) and the modality of delivery (e.g., real people, standard computers, or immersion headsets). With the rapid development of new technologies, programs need to consider whether the associated costs are supported by the purported gains compared to existing lower cost options.

Study Objectives and Significance. The primary aim of this pilot study is to explore whether there is a significant difference in learning outcomes, specifically knowledge acquisition and retention, in undergraduate students who complete an active listening simulation using immersive VR technology and those who complete the same simulation using non-immersive technology (i.e., a standard computer). Because immersive VR fully engages students within the SLE, it is anticipated that students who receive training in this modality will outperform students who complete the simulation using standard computers. A second aim of this study is to explore whether there is a significant difference between undergraduate students' self-reported confidence related to training goals between the two technologies of delivery. It is anticipated that students who complete an SLE using immersive VR technology will make larger gains in their self-reported confidence than those who complete the same simulation using non-immersive technology.

There are two primary research questions addressed in this pilot study. Research questions included the following:

1. Is there a significant difference in learning outcomes between students who complete an SLE using VR headsets and those who complete the same simulation using a standard desktop computer? It is hypothesized that students who complete an SLE using VR headsets will demonstrate greater gains in their learning compared to those who complete the same SLE using standard desktop technology.
2. Is there a significant difference in self-reported confidence engaging in active listening skills between students who complete an SLE and those who complete the same simulation using a desktop computer? It is hypothesized that students who complete a SLE using VR headsets will demonstrate higher self-confidence than their peers who complete the same SLE using a standard desktop computer.

This pilot study will enable CSD programs to make more informed decisions about if and how to incorporate simulation-based learning into their undergraduate training curricula. Additionally, it will help CSD programs make decisions about the technologies used to deliver those simulations by comparing the effect of immersive and non-immersive VR on student learning.

Methods

Participants. This study was approved by the Kansas State University Institutional Review Board. Potential participants completed an active listening simulation as part of regular course requirements during the Fall 2023 and Spring 2024 semesters from upper division undergraduate classes in CSD at a single university in the Midwestern United States. As part of this university's strategic plan, academic innovation, integrating technology into all aspects of the student experience, and engagement with applied learning experiences are all prioritized (Kansas State University, 2023). Course enrollment numbers during this period capped the total sample size to 70 potential participants, all of whom consented for their data to be used in this study. Potential participants were provided with information about this study and an opportunity to ask questions by the second and third authors, who were not affiliated with the courses from which participants were sampled.

Participants were randomly assigned by the first author to complete the simulation using a standard desktop computer (*n* = 35) or using a Meta Quest 2 VR headset (*n* = 35). Because participants completed the simulation as part of their regular course assignments, random assignment was used until half of the available pool per course was assigned to one of the two conditions, at which point any remaining participants were assigned to the remaining condition so that the groups were balanced in number. There were no significant demographic differences between the groups and participant demographics are presented in Table 1. Pretesting was also conducted using the primary learning assessment discussed below to establish group equivalency prior to intervention and identify potential confounds that would affect the interpretation of results.

Intervention. Each participant completed the same active listening simulation (Bodyswaps, 2022), which consisted of a series of interactive modules that introduced active listening, engaged learners in identifying positive and negative active listening behaviors, supported them in identifying potential responses that would indicate active listening, and culminated in learners generating a verbal response to show their simulated communication partner that the learner was engaged in active listening. Within each module, the software provided feedback on the accuracy of the learner’s performance and allowed them to retry each interaction to improve their performance. The Bodyswaps platform is a learning tool that uses realistic, interactive simulations to facilitate knowledge and skill acquisition. In this study, it provided students with a virtual environment to learn about and practice active listening with a simulated communication partner. Interested readers are referred to Bodyswaps (n.d.) for more information about the specific active listening module used in this study.

All participants completed the SLE individually in a quiet room while supervised by a research team member. Participants who completed the training using the Meta Quest 2 headset also received a brief orientation to the hardware. The simulation was identical for all participants except for the technology used to deliver it.

Learning Outcomes. The primary learning outcome measured in this study is participants’ scores on a multiple-choice assessment designed to measure their knowledge of active listening principles and techniques. Participant knowledge of active listening was measured using a multiple-choice assessment developed by the first author based on the content covered during the simulation (see Appendix). This assessment included questions designed to evaluate understanding of key active listening principles such as nonverbal communication, paraphrasing, and question-asking techniques. Participants completed this assessment immediately before intervention, within 24 hours of intervention, and again four weeks post-intervention. Immediately before and after intervention, participants also completed a three-item survey administered by Bodyswaps regarding self-perceptions of their skills. These three items asked participants to rate themselves on a scale from one to five on their ability to listen with full attention, ask thoughtful questions, and summarize key points of the speaker's message.

Table 1

Demographic Characteristics by Condition

Variable	Computer (n=35)	VR Headset (n=35)
Age in Years: Mean (*SD*)	20.94 (*.91*)	20.85 (*1.66*)
Classification		
Sophomore	0	2
Junior	11	11
Senior	24	20
Graduate Student	0	2
Familiarity with Technology[a]: Mean (*SD*)	3.8 (*.68*)	3.74 (*.61*)
Gender		
Female	35	33
Male	0	2
Race		
Asian	0	1
White	33	31
Multiple	0	2
Ethnicity		
Hispanic or Latino	2	1
Not Hispanic or Latino	33	34
Preferred Learning Style		
None	5	6
Auditory	0	1
Kinesthetic	2	6
Visual	18	14
Multiple	10	8

Note: [a] Familiarity with technology was measured on a scale from 1 to 5, with 1 indicating very unfamiliar and 5 indicating very familiar.

All data for this study was collected using the Canvas learning management system or Bodyswaps software to prevent examiner bias influencing participants' responses. Participants and the second and third authors who administered the intervention were aware of each participant's assigned condition by virtue of the different technologies used. However, the authors involved in intervention implementation were blind to study hypotheses during the data collection phase of the study.

Statistical Methods. Participants were upper division undergraduate students and likely had some previous knowledge of active listening. Additionally, the outcome measures were multiple choice assessments, therefore, it was assumed that the data would not meet the assumptions of the general linear model. As such, Mann-Whitney *U* tests were planned to compare outcomes between the group who completed the simulation using immersive technology and those who used a standard desktop computer. The research team reviewed assessment items developed for this study after completing the simulation to review and establish content and face validity, but the small sample size used in the present study precluded statistical assessment of the assessment's validity. Reliability analyses were planned to preliminarily identify the internal consistency of both assessments used in this study.

Results

Seventy participants were randomly assigned to complete an active listening simulation via immersive VR headsets (n = 35) or standard desktop computers (n = 35). Their learning was measured using an author-developed assessment and a survey distributed within the simulation software. Reliability analyses conducted using SPSS indicated that Cronbach's alpha was .635 for the author-developed assessment (see Appendix) and .646 for the survey assessment used by Bodyswaps, which may be considered acceptable for a pilot study with a small sample size even if values of .70 or greater are typically desired (Taber, 2018). Prior to the intervention, there was no significant difference between the two groups in their knowledge of active listening based on their scores on the multiple-choice assessment ($W(70) = 677.5$, $p = .437$). Summary statistics for participants' pretest, posttest, and maintenance scores are reported in Table 2.

Table 2

Active Listening Scores by Condition

Timepoint	Computer					VR Headset				
	Min.	Mdn	*M*	*SD*	Max	Min.	Mdn	*M*	*SD*	Max
Pre	3	7	6.9	1.7	10	4	7	7.2	1.5	10
Post	9	10	9.9	0.4	10	9	10	9.9	0.3	10
Maintenance	9	10	9.9	0.3	10	8	10	9.9	0.4	10

There was also no significant difference between the two groups before the intervention in self-reported confidence in the key active listening skills covered in the simulation, including listening with full attention ($U(69) = 613$, $p = .800$), asking thoughtful questions ($U(69) = 499$, $p = .223$), and summarizing key points of their communication partner's message ($U(69) = 449$, $p = .051$). Summary statistics for participants' pretest and posttest self-reported confidence using these active listening skills are reported in Table 3.

Table 3

Self-Reported Confidence in Active Listening

Condition	Pre-Intervention					Post-Intervention				
	Min	Mdn	Mn	SD	Max	Min	Mdn	Mn	SD	Max
Computer										
Listening Demonstrably	3	4	3.82	0.76	5	3	4	4.26	0.62	5
Thoughtful Questions	2	4	3.71	0.94	5	2	4	4.12	0.84	5
Summarizing Key Points	2	4	3.59	0.7	4	3	4	4.12	0.81	5
VR Headset										
Listening Demonstrably	2	4	3.77	0.6	4	3	4	3.94	0.64	5
Thoughtful Questions	2	3	3.51	0.82	5	2	4	3.86	0.85	5
Summarizing Key Points	3	3	3.4	0.6	5	3	4	3.6	0.65	5

Active Listening Concept Knowledge. Gain scores defined as participants' change between pre- and post-testing on the active listening knowledge assessment (see Appendix) and their maintenance of these changes were examined to identify whether there was a significant difference between intervention groups. As expected, the data did not meet the assumption of normality for gain ($W(70) = .951$, $p < .05$) or maintenance scores ($W(70) = .549$, p <. 001). Summary statistics by condition are reported in Table 4. A Mann-Whitney *U* test was used to identify whether there was a significant difference between participants who completed the simulation using immersive VR technology and those who completed the simulation using a standard desktop computer. There was not a significant difference between the groups' gains from pre-test to post-test ($U = 560.5$, $p = .535$, $r = .46$ [95%: 0.25, 0.63]) or at the maintenance timepoint ($U = 596.5$, $p = .766$. $r = .49$ [95%: 0.29, 0.65]). Although there was not a statistically significant difference between the two groups, there was a medium effect of intervention favoring the group who completed the simulation using immersive VR technology at both timepoints ($r = .46, .49$). This practical difference is consistent with the hypothesis that participants who completed the simulation using immersive VR technology would demonstrate a practical advantage in learning compared to their peers who used a standard desktop computer.

Table 4

Active Listening Gain Scores by Condition

Timepoint	Computer					VR Headset				
	Min.	Mdn	*M*	*SD*	Max	Min.	Mdn	*M*	*SD*	Max
Pre - Post	0	3	2.94	1.64	6	0	3	2.69	1.53	6
Post - Maintenance	0	0	0.00	0.42	1	-1	0	-0.03	0.38	1

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Active Listening Confidence. Participants' gains in self-confidence between pre- and post-testing were also evaluated to identify whether there was a significant difference between intervention groups after completing the simulation. As expected, the data did not meet the assumption of normality for any of the skills for either condition, with all Shapiro-Wilks tests resulting in $p < .001$. Summary statistics for gain scores by condition are reported in Table 5. As such, non-parametric Mann-Whitney *U* tests were used to identify whether there was a significant difference in gains in self-reported confidence between participants who completed the training via immersive VR and those who completed the training using non-immersive VR. There was not a significant difference between groups for listening with full attention ($U = 492.50$, $p = .109$, $r = .40$ [95%: .18, .58]), asking thoughtful questions ($U = 581$, $p = .680$, $r = .47$ [95%: .26, .63]), or summarizing key points of their communication partner's message ($U = 500.5$, $p = .158$, $r = .41$ [95%: .19, .59]). Medium effects of intervention favoring the group who completed the simulation using VR headsets were observed on all three self-confidence items ($r = .40, .47, .41$). This is consistent with the hypothesis that students who completed the simulation using immersive VR technology would demonstrate a practical advantage over their peers who used the standard desktop technology.

Table 5

Self-Reported Confidence in Active Listening Gain Scores

Condition	Min	Mdn	Mn	SD	Max
Computer					
Listening Demonstrably	0	0	0.43	0.5	1
Thoughtful Questions	0	0	0.4	0.5	1
Summarizing Key Points	-1	0	0.51	0.82	2
VR Headset					
Listening Demonstrably	-1	0	0.17	0.66	1
Thoughtful Questions	-1	0	0.34	0.84	2
Summarizing Key Points	-1	0	0.2	0.76	1

Discussion

Support of Original Hypotheses. This pilot study explored the degree to which the technology used to deliver an SLE (i.e., a standard desktop computer or a VR headset) influenced students' knowledge and self-reported confidence related to the simulation's content. Although there was not a statistically significant difference between conditions on participants' gain scores at post-test ($p = .535$) or at the maintenance ($p = .766$) timepoint, there was a medium effect of intervention at both ($r = .46, .49$). This does not support the original hypothesis that undergraduate CSD students who completed the simulation using immersive technology would outperform their peers who experienced the same simulation on standard desktop computers.

There was also not a significant difference in increased students' self-perceptions of confidence in using active listening skills between those who completed the simulation using the immersive VR headsets and students who used standard desktop computers (p = .109, .680, and .158). This does not support the original hypothesis that students who were more fully immersed in the simulation would outgain their peers who completed the SLE using standard desktop computers. However, there were medium effects of intervention favoring the VR group (r = .40, .47, .41), suggesting that there may be a benefit to completing simulations using VR technology over standard desktop computers.

Similarity of Results. The results of the present study are consistent with that previously reported on VR instruction. Coban and colleagues (2022) reported an average effect of g = .38 for VR instruction and Merchant and colleagues (2014) systematic review of VR instruction reported a mean effect size of .41 for simulation-based instruction. Merchant and colleagues' review also found that studies reporting on students' acquisition of knowledge found, on average, larger effects of simulation-based instruction than those reporting on skill acquisition. This is consistent with the findings of the present pilot study, which used multiple choice assessments of students' knowledge related to content covered in the simulation.

Interpretation and Implications. Although there were no statistically significant differences between groups in the present study, effect sizes were consistently positive and in the medium range (Cohen, 1988). The 95% confidence intervals for the effects identified in this pilot study do not include zero, suggesting there may be a practical difference between SLEs delivered using VR technology and standard desktop computers despite the small sample size. The small sample in this pilot provides limited statistical power, which likely helps explain the lack of statistical significance between groups when looking for a small effect of intervention between the two groups.

These medium effect sizes obtained on both study outcomes suggest that immersive VR simulations might offer an educational advantage over standard desktop-based simulations, even if these advantages did not achieve statistical significance in this pilot study. The practical implications of these findings include the potential for immersive VR technology to enhance engagement and motivation among students, which may lead to better retention and application of learned skills.

This study was conducted with undergraduate students at a single university in the Midwestern United States. Although demographic data for undergraduate students majoring in CSD in the US is not readily available, the demographics of the present sample align with the demographics of current practitioners reported by ASHA (2024). Random assignment of participants to conditions also increases the external validity of this study despite its relatively small sample (N = 70) although the small sample is a concern as it is likely underpowered to find robust effects that are clearly not attributable to chance. Future studies with larger samples recruited from multiple universities are needed to confirm the relevance of these findings and better identify the effects associated with SLEs that are completed using VR technologies in CSD.

This study contributes to the existing literature on teaching and learning in CSD by providing preliminary evidence on the relative effects of immersive VR and standard desktop technologies on student learning in CSD that is consistent with previous estimates from the broader literature (Coban et al., 2022; Merchant et al., 2014). This study also contributes quantitative evidence of this effectiveness that can be used in conjunction with previous studies' qualitative approach to understanding students' perceptions of SLEs and VR technologies (Kelly et al., 2023).

Reflection on Teaching Practice. As CSD programs adapt their curricula to be responsive to the needs of their students, it is important to consider how best to incorporate technology and simulation into those plans. Although simulations are increasingly used in graduate training programs, the present study also suggests they can be useful in the undergraduate CSD curriculum. The lack of statistical significance but presence of medium effects favoring the use of immersive VR to deliver this SLE may be encouraging for academic and clinical faculty to explore adaptations to current instructional methods.

A challenge of the present study was the researchers' limited access to immersive VR headsets, so faculty should consider whether the skill or content being delivered via immersive VR warrants the need for the additional resources in terms of finances, time, and space. Faculty might consider targeting content that might otherwise be difficult to teach using standard technology or in vivo instruction, such as conflict management. Similarly, areas in which the primary goal is to help students feel more confident might be appropriate targets for instruction using immersive VR given the medium effects observed on the self-report measure. For example, the first author would consider more intentionally using immersive VR to engage students in SLEs related to conducting caregiver interviews, navigating challenging conversations with other professionals, or counseling. Additionally, feedback from participants emphasized the importance of intentional pre-briefing and debriefing procedures to support learning (El Hussein et al., 2021), which were absent from the present study. An alternative consideration might be to make SLEs delivered via immersive VR available on an as-needed basis for students immediately prior to a relevant academic or clinical experience, such as using the SLE reported in Kelly and colleagues (2023) prior to students' first opportunity to conduct an oral mechanism exam in clinic.

Directions for Future Research. Future research should expand on this work by continuing to investigate technologies used to deliver SLEs in CSD at the undergraduate and graduate levels. For CSD faculty to make informed decisions about how to deliver SLEs in their programs, more research is needed on how technologies compare when covering similar content such as was done in the current study and previous work by Ewing (2015). Future research should also continue exploring the utility of VR and computer-based simulations in pre-service CSD training programs, especially as they support long-term retention of trained knowledge and skills. Although the present study measured maintenance of gains four weeks after instruction, future research should consider longer maintenance time points and/or transfer of trained skills into other settings, such as on- or off-campus clinical rotations. Because there is significantly more work on students' perceptions of SLEs, future research should explore how student perceptions potentially interact with or influence learning outcomes of SLEs.

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Appendix

Pre- and Post-Test Questions over Simulation Content

1. What is the primary goal of active listening?
   a. To interrupt the speaker
   b. To minimize the speaker's concerns
   c. To offer advice to the speaker
   d. To understand the speaker
2. Which type of question is recommended to be used during active listening?
   a. Closed
   b. Judgmental
   c. Open
   d. Rhetorical
3. Which is something you should do while engaging in active listening?
   a. Acknowledge and validate emotions
   b. Avoid making eye contact
   c. Interrupt the speaker to share your own related experience
   d. Offer solutions to the speaker
4. Which approach is recommended when addressing your communication partner while engaging in active listening?
   a. Avoid using their name to distance the person from the problem
   b. Make "you" statements to humanize the problem
   c. Use their name to establish a personal connection
   d. Refer to other people by name except for your communication partner
5. Why are closed questions discouraged during active listening?
   a. They elicit one-word responses
   b. They make it seem like you genuinely care about the speaker
   c. They help to maintain conversational flow
   d. They offer too much insight into the speaker's thoughts and feelings
6. What is the purpose of summarizing when engaged in active listening?
   a. To interrupt the speaker and maintain control over the conversation
   b. To prioritize feelings over facts during the conversation
   c. To show them that you are having to use a strategy to maintain interest
   d. To validate the communication partner's feelings and check your understanding
7. When summarizing during active listening, what is the recommended way to express your communication partner's thoughts?
   a. Relate their words to your own personal experience
   b. Remind them of previous experiences they have encountered
   c. Repeat their exact words
   d. Paraphrase their words
8. Which should you **NOT** do when engaging in active listening?
   a. Address your communication partner by name
   b. Interrupt the speaker to summarize
   c. Offer solutions when asked to do so
   d. Validate your communication partner's feelings
9. What should you do to encourage trust and understanding while active listening?

   a. Minimize concerns
   b. Offer judgments and advice
   c. Share your own experiences
   d. Validate your communication partner's feelings
10. What does active listening focus on capturing?
   a. How you and your communication partner are similar
   b. What you would do if you were in their position
   c. Your communication partner's story and feelings
   d. Your previous experiences and feelings