The Acquisition Of Static And Dynamic Intervention Skills By Graduate Speech-Language Pathology Students

By: **George W. Wolford,** Ethan J. Wash, Matthew P. Stowers,
Ashley R. McMillon, and Arianna N. LaCroix

Abstract

Purpose: Speech-language pathology programs use simulated learning experiences (SLEs) to teach graduate student clinicians about fidelity to therapeutic interventions, including static skills (clinical actions that are delivered in a pre-specified way regardless of the client's behavior) and dynamic skills (contingent responses formulated in response to a client's behavior). The purpose of this study was to explore student learning of static and dynamic skills throughout SLEs and live clinical practice. Method: Thirty-three speech-language pathology graduate students participated in this study. Students were first trained to deliver an intervention before having their treatment fidelity measured at three time points: an initial SLE, actual clinical practice, and a final SLE. Treatment fidelity was first summarized using an overall accuracy score and then separated by static and dynamic skills. We hypothesized that (a) overall accuracy would increase from the initial simulation to treatment but remain steady from treatment to the final simulation and that (b) students would acquire dynamic skills more slowly than static skills. Results: In line with our hypotheses, students' overall accuracy improved over time. Although accuracy for static skills was mostly established after the first simulation, dynamic skills remained less accurate, with a slower acquisition timeline. Conclusions: These results demonstrate that SLEs are efficacious in teaching students the clinical skills needed for actual clinical practice. Furthermore, we show that dynamic skills are more difficult for students to learn and implement than static skills, which suggests the need for greater attention to dynamic skill acquisition during clinical education.

George W. Wolford, Ethan J. Wash, Matthew P. Stowers, Ashley R. McMillon and Arianna N. LaCroix (2024). The Acquisition of Static and Dynamic Intervention Skills by Graduate Speech-Language Pathology Students, *The American Journal of Speech-Language Pathology*, March 2024, pp.1-12. Publisher version of record available at: https://pubs.asha.org/doi/10.1044/2024_AJSLP-23-00291

ASHA American Speech-Language-Hearing Association

AJSLP

Research Note

The Acquisition of Static and Dynamic Intervention Skills by Graduate Speech-Language Pathology Students

George W. Wolford,[a] Ethan J. Wash,[b] Matthew P. Stowers,[b] Ashley R. McMillon,[b] and Arianna N. LaCroix[c]

[a] Department of Rehabilitation Sciences, Beaver College of Health Sciences, Appalachian State University, Boone, NC [b] College of Health Sciences, Midwestern University, Glendale, AZ [c] Department of Speech, Language, and Hearing Sciences, College of Health and Human Sciences, Purdue University, West Lafayette, IN

ARTICLE INFO

Article History:
Received August 7, 2023
Revision received December 6, 2023
Accepted January 26, 2024

Editor-in-Chief: Erinn H. Finke
Editor: Bryan Ness

https://doi.org/10.1044/2024_AJSLP-23-00291

ABSTRACT

Purpose: Speech-language pathology programs use simulated learning experiences (SLEs) to teach graduate student clinicians about fidelity to therapeutic interventions, including static skills (clinical actions that are delivered in a prespecified way regardless of the client's behavior) and dynamic skills (contingent responses formulated in response to a client's behavior). The purpose of this study was to explore student learning of static and dynamic skills throughout SLEs and live clinical practice.
Method: Thirty-three speech-language pathology graduate students participated in this study. Students were first trained to deliver an intervention before having their treatment fidelity measured at three time points: an initial SLE, actual clinical practice, and a final SLE. Treatment fidelity was first summarized using an overall accuracy score and then separated by static and dynamic skills. We hypothesized that (a) overall accuracy would increase from the initial simulation to treatment but remain steady from treatment to the final simulation and that (b) students would acquire dynamic skills more slowly than static skills.
Results: In line with our hypotheses, students' overall accuracy improved over time. Although accuracy for static skills was mostly established after the first simulation, dynamic skills remained less accurate, with a slower acquisition timeline.
Conclusions: These results demonstrate that SLEs are efficacious in teaching students the clinical skills needed for actual clinical practice. Furthermore, we show that dynamic skills are more difficult for students to learn and implement than static skills, which suggests the need for greater attention to dynamic skill acquisition during clinical education.

Simulated learning experiences (SLEs) are used by speech-language pathology graduate programs at an increasing rate to bridge the gap between academic knowledge and clinical practice (Busch & Ma, 2023; Dudding et al., 2017; Hill et al., 2021). Graduate programs use SLEs to teach technical skills, introduce students to interprofessional education, and develop practice patterns for low-incidence populations (Busch & Ma, 2023; Howells et al., 2019; Lewis et al., 2018; L. L. Wolford & Wolford, 2020). The most compelling evidence for SLEs in the field comes from a multisite randomized control trial, which found that students acquire similar clinical competencies in a 100% supervised live clinical setting as they do in a setting where 20% of clock hours were acquired through SLEs (Hill et al., 2021). Furthermore, SLEs are efficacious, yielding successful skill development in multiple formats, and students report feeling more confident about working with clients with communication disorders after completing SLEs (Busch & Ma, 2023; Issenberg et al.,

Correspondence to George W. Wolford: wolfordgw@appstate.edu.
Disclosure: *The authors have declared that no competing financial or nonfinancial interests existed at the time of publication.*

2005; Moineau et al., 2018; Thomas et al., 2023; Ward et al., 2014, 2015; L. L. Wolford & Wolford, 2020; Zraick et al., 2003). Although the SLE literature is robust, knowledge gaps remain in part due to methodological choices and outcomes extracted.

Many SLE studies use between-subjects designs that compare two or more groups across two time points using a pre–post between-subjects design (e.g., Benadom & Potter, 2011; Clinard, 2022; Ferguson & Estis, 2018; Hill et al., 2021; L. L. Wolford & Wolford, 2020; Zraick et al., 2003). These studies often compare an SLE experimental group to a control group that participates in either standard clinical practice or a no learning condition. Students who participate in SLEs perform equivalently to or outperform students in the control group. These between-subjects designs are largely used to prepare students for administering standardized assessments rather than intervention and quantify student success using aggregated measures (e.g., overall confidence, self-efficacy, or percent accuracy) rather than examining individual types of skills (Broadfoot & Estis, 2020; Dudding & Nottingham, 2018; Moineau et al., 2018). Consequently, there is limited information about how students acquire different types of treatment skills and how an individual student can apply the skills learned during an SLE into real clinical practice (Norman et al., 2012; Ward et al., 2014; G. W. Wolford et al., 2021).

Investigating how students acquire treatment skills is important, since the skill sets for assessment and treatment are not equivalent. For instance, (standardized) assessment protocols are largely static in that the clinician delivers the same set of items using prespecified language to each client regardless of their responses. Intervention protocols also contain static directions; yet, they are additionally dynamic, meaning the clinician's responses are contingent on the client's behavior. In aphasia treatment protocols, these dynamic responses are usually guided by a cueing hierarchy embedded within the static elements of the protocol. For instance, in Verb Network Strengthening Treatment (VNeST), the protocol starts with a static step where the clinician asks the client to identify the agent of a specific verb/action (Edmonds et al., 2014). This step is static in that it is part of the protocol and is executed by the clinician in the same manner each time. When the client provides an incorrect response to this static step, the clinician employs a cueing hierarchy to assist the client in generating a more appropriate response (Edmonds et al., 2014). The utilization of cueing hierarchies introduces a dynamic element, as the cues need to be tailored to the individual client and the targeted verb.

There is limited quantitative information in the literature on how student clinicians learn to implement cueing hierarchies. However, a recent qualitative study on the experiences of four graduate students implementing constraint induced aphasia therapy indicates that students feel challenged by cueing hierarchies and are initially only comfortable implementing "straightforward" cues (Dincher et al., 2020). The challenges that students face in acquiring dynamic skills can be explained by cognitive load theory (CLT). According to CLT, tasks with higher intrinsic loads are more challenging to learn and execute compared to tasks with lower intrinsic loads due to differences in the amount of working memory required to execute the task (Sweller et al., 1998; Young et al., 2014). Dynamic skills, such as cueing hierarchies, carry higher intrinsic loads than static skills. This is because successfully implementing a cueing hierarchy involves the clinician analyzing errors in real time, understanding why they occurred, and responding contingently. In contrast, executing a static prompt only requires the clinician to be aware that they need to follow the protocol's procedures.

The purpose of this study was to investigate how speech-language pathology graduate student clinicians learn static and dynamic intervention skills. We were additionally interested in whether the skills learned during an SLE transfer into actual clinical practice. Using a within-subjects design, treatment fidelity was measured at three time points for each student: an initial SLE, clinical practice (treatment with real patients), and a final SLE. We first summarized treatment fidelity using a total accuracy score and then separated out static and dynamic skills. We hypothesized that students would acquire dynamic treatment skills more slowly than static treatment skills, and that this difference would only be observed when intervention element was entered into the analyses separately, rather than as an aggregate (total accuracy) score. We additionally hypothesized that students would demonstrate an increase in performance from the initial SLE to treatment, reflecting the student's ability to incorporate supervisory feedback when applying the skills learned during the SLE to real clinical practice.

Method

Participants

Ethical approval for this study was granted by the Midwestern University institutional review board, and students gave written informed consent to participate. Thirty-six speech-language pathology graduate students consented to participate in this study as part of a 10-week on-campus clinical rotation. Our final sample included 33 participants (M = 25 years old, SD = 2.27; 31 identifying as female) as three students were excluded due to missing recordings of the simulation data. These 33 students had 54.8 clock hours (SD = 31.27) on average with the least experienced cohort (see Appendix A, Cohort 3, N = 5) having 0 clock hours and the most experienced cohort (see Appendix A, Cohort 2, N = 6) having 93 clock hours (SD = 9.5). Nine students had prior experience working with a client with aphasia. Participants had an average undergraduate grade point average of 3.38 (SD = 0.23), an aphasia course grade of 88.5% (SD = 4.54) and had completed at least one assessment SLE prior to study enrollment.

The students were all enrolled in a graduate program that took seven quarters to complete. Students completed all coursework during the first five quarters; the aphasia course was offered during students' second quarter on campus. The program's structure resulted in 28 of 33 students taking the aphasia course prior to enrolling in the study, while five of 33 (see Appendix A, Cohort 3) took the aphasia course concurrently with study enrollment. Students acquired approximately 100 clinical clock hours during four on-campus clinical rotations, beginning in their second quarter. Students then completed their remaining clock hours during two external rotations.

Procedure

This study is part of a larger protocol that investigated training and clinical education models within the context of an aphasia treatment program (see G. W. Wolford et al., 2023). All students, except for six, implemented the program virtually due to university policies regarding the COVID-19 pandemic. Students were first taught the treatment protocol, VNeST, either synchronously or asynchronously.[1] The trainings included the steps of the VNeST protocol with examples of implementation. Students participated in two simulation experiences, one after training (initial SLE) and one after completing the clinical rotation (final SLE). During the SLEs, the clinical educator (E.J.W.) played the role of a client with moderate Broca's aphasia. The SLEs were standardized so that the clinical educator made planned errors that required maximal cueing at specific points in the protocol; this allowed all students to demonstrate each step of each cueing hierarchy (see Appendix B). In between the initial and final SLEs, students participated in supervised clinical practice where they were scheduled to deliver 16–30 hr of VNeST to a client with aphasia. As is typical in clinical practice, aphasia type (Anomic: 43%, Conduction: 10%, Broca's: 33%, Wernicke's: 14%) and severity (Western Aphasia Battery–Revised [Kertesz, 2006] Aphasia Quotient M = 62.75, SD = 25.2; mild: 38%, moderate: 29%, severe: 33%) differed across clients.

[1]Training group did not impact treatment fidelity on the initial SLE in G. W. Wolford et al. (2023). Therefore, training groups were combined here for ease of interpretation.

The same clinical educator (E.J.W.), who played the role of the client with aphasia during the SLEs, supervised the intervention sessions for all students except in rare circumstances such as illness. The clinical educator, who had weekly experience using VNeST in his own clinical practice and 2 years of experience as a university clinical educator, provided feedback on the student's ability to administer all items on the VNeST protocol after each SLE and treatment session. Feedback was provided to students verbally in a one-on-one setting following the SLEs. For treatment, feedback was primarily delivered verbally during postsession group debriefs that lasted approximately 15–30 min. Written feedback was also occasionally delivered during the session using the in-session messaging feature for students participating in the telehealth version. Regardless of the delivery format, feedback was individualized to each student, and all postsession debriefs included a discussion of the error(s) made and demonstration of correct administration of the item(s) to promote student learning and protocol fidelity.

Coding

The VNeST protocol was adapted from Conlon et al. (2020) and is presented in detail in Appendix B. Each specific action that a clinician takes in the VNeST protocol is described as an "item," and groups of items are "steps" (Conlon et al., 2020). Each item was scored as *correct* (1), *incorrect* (0), or *not applicable* (N/A). An item was scored as correct if the student implemented it as intended. An item was scored as incorrect if the student failed to administer the item, made an error during administration, or if the clinical educator implemented an item rather than the student. We elected to code the clinical educator's intervention as incorrect for the student, because the clinical educator solely intervened as a corrective technique rather than prospectively planning to model a portion of the protocol (as in other protocols, e.g., Donaldson et al., 2015). An item was coded as N/A if the participant responded without the student generating the item or if the response was not required in that context, which only occurred for dynamic items. The total accuracy for each step was scored as a percentage of the number of items that the student correctly administered within the step divided by the total number of items in the step; an N/A response was not counted in the numerator or denominator.

The first author coded all the data, and two trained graduate students coded approximately 10% each of the treatment and simulation data so that interrater reliability could be calculated. All coders were blinded to SLE time point (initial vs. final), but the treatment sessions were apparent since clients were present. However, the coders did not have access to the simulation data during the coding of the treatment time point, meaning they did not know the student's baseline or final performance. Differences were resolved by consensus or by re-examining the video recordings. The interrater reliability was $\kappa = .89$ for the simulation data and $\kappa = .78$ for the treatment data. Kappa values above .90 are considered almost perfect, between .80 and .90 are considered strong, and values .60 to .79 are considered moderate agreement (McHugh, 2012). The slight difference in interrater reliability between the treatment and simulation data is likely due to greater variability in the treatment data due to the presence of different clients with different cueing needs, which likely resulted in students needing different levels of support from the clinical educator.

Three time points were coded: (a) the initial SLE, (b) the first time that a student implemented the treatment with their client[2] (hereafter referred to as the treatment time point), and (c) the final SLE. The initial SLE represents a baseline behavior after a didactic training and shows the results of simulation learning, whereas the final SLE shows the results of learning from the clinical rotation. The treatment time point provides information about how the students learned from the feedback provided after the initial SLE.

Adaptations to Fidelity Protocol Scoring

We made a few retrospective changes to fidelity scoring to ensure that the treatment and simulation phases were scored equivalently. For instance, during treatment, students were provided with a PowerPoint shell that included the written wh-words in Steps 1 and 3 (see Appendix C). The PowerPoint shell was not given to students during the SLEs, meaning they were expected to generate the wh-prompts from memory. We therefore excluded these two items (Items 1 and 25 in Appendix B) from the analyses as students demonstrated near ceiling performance on these items during treatment.

We additionally excluded the reading hierarchies (Items 23, 29, 32, 33, and 37 in Appendix B) from the analyses due to challenges with implementing choral reading during teletherapy. Choral reading during teletherapy led to distorted audio, which undermined the therapeutic function of this step. Students adapted to this issue in different ways: Some students paused after each word to allow the client the opportunity to say the word, others attempted choral reading, and others had a caregiver conduct choral reading. As such, accepting or rejecting all adaptations does not meaningfully reflect student learning.

[2]We used the second treatment session in place of the initial treatment session for two students due to missing data.

Statistical Analyses

Two analyses occurred in parallel: total accuracy and intervention skills. For total accuracy, we computed each student's average performance across all items in the protocol at each time point (i.e., one aggregate score per student for each step). In the intervention skills analysis, we analyzed the type of intervention skill, static and dynamic, separately. Items that were always delivered and were delivered the same way each time were labeled as static skills. For example, Item 2 required the clinician to select a verb and then ask, "Who can {verb} something/someone?" (Conlon et al., 2020, p. 424; Edmonds et al., 2014). Clinicians deliver this item the same way each time while only varying the targeted verb. Items that were not always delivered and could potentially be delivered in different ways were labeled as dynamic skills. For example, Item 3 required the clinician to provide a cueing hierarchy only if the client made an error on Item 2. The cues would be individualized to the client and verb in the moment; thus, they were dynamic and not preset. See Appendix B for a complete list of the skills considered static and dynamic. The intervention skill analysis resulted in two data points (one static and one dynamic) per student per time point.

All statistical analyses were completed in the statistical software R (R Core Team, 2022). A within-subjects, repeated measures analysis of variance (ANOVA) was specified using the "afex" package (Singmann et al., 2022) to determine whether students' total accuracy and intervention skill accuracy differed across the three time points. Type III ANOVAs were specified because of the potential of interaction effects. The Greenhouse–Geisser correction was used when sphericity was violated. Post hoc testing was done by applying the Holm correction to the estimated marginal means using the "emmeans" package (Lenth, 2022).

Results

Total Accuracy

A one-way repeated-measures ANOVA with three levels of Time (initial SLE, treatment, and final SLE) was computed. The main effect of Time was significant, $F(1.36, 43.47) = 50.53$, $\eta^2_G = .478$, $p < .001$. Students' performance was lower on the initial SLE ($M = 61.8$, $SD = 17.70$) compared to the final SLE, $M = 88.0$, $SD = 7.95$, $t(32) = -7.54$, $p < .001$; and treatment, $M = 85.2$, $SD = 9.40$, $t(32) = -7.48$, $p < .001$. The treatment time point ($M = 85.2$, $SD = 9.40$) did not differ from the final SLE, $M = 88.0$, $SD = 8.90$, $t(32) = -1.70$, $p = .10$.

Intervention Skills

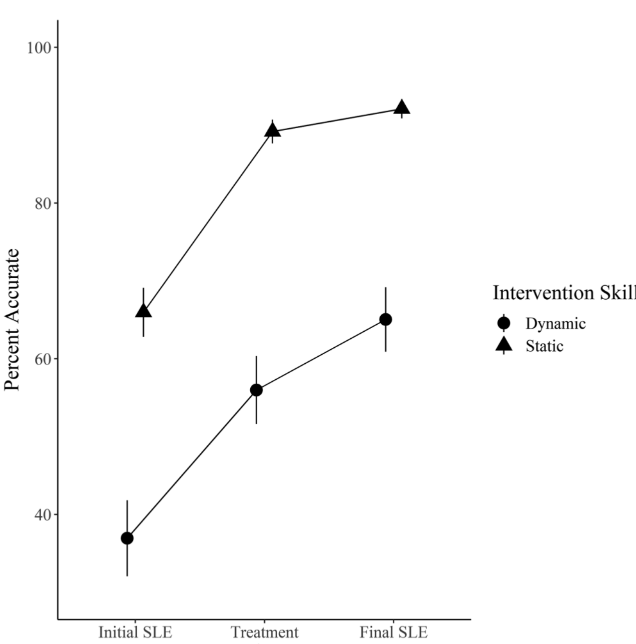
A two-way repeated-measures ANOVA with three levels of Time (initial SLE, treatment, and final SLE) and two levels of Intervention Skill (static and dynamic) was specified. The main effect of Time was significant (see Figure 1), $F(1.56, 49.77) = 30.60$, $p < .001$; $\eta^2_G = .256$. Students' performance was lower on the initial SLE, $M = 51.5$, $SD = 27.59$, compared to the final SLE, $M = 78.6$, $SD = 22.14$, $t(32) = -6.603$, $p < .001$; and treatment, $M = 72.6$, $SD = 25.05$, $t(32) = -5.16$, $p < .001$. Students also had lower performance on treatment, $M = 72.6$, $SD = 25.05$, than the final SLE, $M = 78.6$, $SD = 22.14$, $t(32) = -2.41$, $p = .02$.

The main effect of Intervention Skill was also significant (see Figure 1), $F(1, 32) = 118.57$, $p < .001$; $\eta^2_G = .360$: Students were more accurate with static skills, $M = 82.4$, $SD = 16.92$, than dynamic skills, $M = 52.7$, $SD = 28.03$. The interaction between Time and Intervention Skill was not significant, $F(1.95, 62.49) = 0.69$, $p = .50$; $\eta^2_G = .004$.

Discussion

The purpose of this study was to investigate how speech-language pathology graduate students acquire static and dynamic skills in the context of an aphasia treatment protocol. We were additionally interested in how skills taught during SLEs transfer to actual clinical practice. In line with the latter aim, we found that students made substantial gains in accuracy between the initial SLE and treatment time points; however, less growth was observed between the treatment and final SLE. This finding reaffirms previous research that demonstrates that SLEs are valuable educational experiences for graduate students to develop clinical skills (e.g., Hill et al., 2021). These results additionally suggest that students can translate the intervention skills learned during an SLE into clinical practice (with high fidelity), particularly when the SLE includes individualized feedback, as occurred in this protocol (Cantrell, 2008; Decker et al., 2013). This is important since the primary instructional aim of clinically relevant SLEs is to teach students to implement protocols with fidelity.

Figure 1. Changes in intervention skill acquisition across time. SLE = simulated learning experience. Error bars reflect ±1 standard error.



The intervention skills analysis added nuance to the results by showing that students learned static skills more easily than dynamic skills. This analysis also revealed that static skills are acquired earlier in the clinical rotation, whereas dynamic skills were still not mastered by the end (i.e., < 80% on average; Conlon et al., 2020). The decreased accuracy for dynamic skills compared to static skills aligns with our hypothesis, as well as a recent qualitative study showing that dynamic skills were more challenging for students to acquire than static skills (Dincher et al., 2020). Static skills are likely easier for students to acquire, because they are produced the same way each time. In a way, static skills can be memorized. In contrast, dynamic skills, such as cueing hierarchies, require the clinician to respond contingently to the client. CLT suggests that dynamic skills are learned more slowly than static skills due to their higher intrinsic load (Sweller et al., 1998). Accurately administering the cueing hierarchy is an intrinsically challenging task because the client can provide all ranges of responses.

CLT also predicts that inexperienced students will have greater difficulty implementing dynamic skills. The cognitive demands of real-time analysis and adaptation are compounded by limited experience in the therapeutic environment in which some behaviors have not yet become automatic (i.e., germane load; Fraser et al., 2015; Sweller et al., 1998; Young et al., 2014). Consistent with CLT's predictions, an exploratory ANOVA examining the impact of having a prior clinical rotation (a proxy for clinical experience) on skill acquisition revealed a significant Experience × Intervention Skill interaction, $F(1, 31) = 11.23$, $p = .002$: The most inexperienced students (Cohort 3, see Appendix C) had greater difficulty acquiring dynamic skills than students in the other cohorts, $t(31) = -2.71$, $p = .011$, but there were no differences in static skill acquisition across the cohorts, $t(31) = 0.339$, $p = .737$. This analysis indicates that the students in their first clinical rotation struggled more with dynamic skills than those with prior clinical experience. To address these needs, clinical education models suggest that clinical educators should provide explicit directions and static scripts to enhance student learning particularly for more novice students (Anderson, 1988; Peña & Kiran, 2008), who likely benefit from a reduction in cognitive load. The reduction of extraneous cognitive load facilitates students in adapting to the therapeutic environment, a crucial step that needs to occur before dynamic intervention can be delivered. However, additional research is needed to identify the necessary supports for early stage learning that ensure higher fidelity and accelerated skill acquisition.

Clinical Education Takeaways

There are two main clinical education takeaways that this study helps to inform. The first is that clinical educators should place additional emphasis on supporting and monitoring the acquisition of dynamic intervention skills, since these are the skills that are more difficult for students to acquire, despite being critical to effective intervention. In contrast, static skills can be taught rather quickly, mostly through didactic instruction. Although static skills appear to remain relatively stable throughout the rotation, clinical educators should continue to monitor student performance in this area, particularly since not all students achieved the 80% mastery level (Conlon et al., 2020) by the final SLE (see Appendix A). The second takeaway is that understanding the differences in static versus dynamic patterns can likewise be valuable for identifying students who may need additional support or who are at risk of remedial performance. The students who struggle with dynamic tasks may be performing within the expected range—especially in their early educational career—but the students who struggle with both dynamic and static tasks may need extra support to succeed.

Limitations and Future Directions

The primary limitation of this study is that there was variability in terms of student experience within the program. For example, students were initially trained to administer VNeST using different materials (Wolford et al., 2023). There was also variability in how many direct VNeST administration hours students acquired during the rotation, when students took the aphasia course, and in the types of clients they worked with. Although individual plots of each student's performance across time indicates that our findings regarding the acquisition of static versus dynamic skills is observed across all students (see Appendix A), future studies are still needed to explore potential student and client variables that may be impacting student skill acquisition. Expanding these research findings into other treatment protocols would also be beneficial to understand whether these acquisition patterns are specific to VNeST or student skill acquisition more generally. Additional research is also needed to address how best to teach dynamic skills in a single clinical education rotation with the goal of student mastery as few students implemented dynamic skills with 80% accuracy on the final SLE (see Appendix A).

A final limitation of this study is the potential for coder bias. While all coders were blinded to whether the simulations were initial or final sessions, the same could not be done for the treatment sessions. Coders would not know if a simulation was initial or final but could recognize actual clients at the treatment time point. We attempted to mitigate this issue by withholding coder access to the accuracy data, which allowed us to blind the coders to the student's baseline and final performance when coding the treatment data. Another potential issue with coding is that the first author was the primary coder. While two additional coders scored 10% of the treatment and simulation data, resulting in strong interrater reliability, future studies should consider a design that allows for complete blinding of the coder to conditions.

Conclusions

This study aimed to understand whether students acquired dynamic and static skills similarly and whether skill acquisition can be transferred from an SLE into actual clinical practice. Regarding Aim 1, our results suggest that students acquire static intervention skills with training relatively quickly. However, dynamic skills are more challenging and take longer to acquire and therefore should be the focus of clinical instruction, particularly since they are the active ingredients (Turkstra et al., 2016) that individualize therapy. We additionally show that students transfer the skills learned in an SLE into actual clinical practice, but that aggregating intervention elements into a total accuracy score is less informative than analyzing individual intervention skills (i.e., static vs. dynamic), particularly when trying to understand how students acquire clinical skills from SLEs.

Data Availability Statement

A de-identified partial data set is available by reasonable request from the first author (G.W.W.) via e-mail.

Acknowledgments

No grant funding was received for this work. The authors would like to thank the students who participated in the study. They would also like to acknowledge the efforts of the faculty and staff who supported this project. This work was supported by Midwestern University, Appalachian State University, and Purdue University.

References

Anderson, J. L. (1988). The supervisory process in speech-language pathology and audiology. *Ear and Hearing, 9*(4), 223. https://doi.org/10.1097/00003446-198808000-00019

Benadom, E. M., & Potter, N. L. (2011). The use of simulation in training graduate students to perform transnasal endoscopy. *Dysphagia, 26*(4), 352–360. https://doi.org/10.1007/s00455-010-9316-y

Broadfoot, C. K., & Estis, J. M. (2020). Simulation-based training improves student assessment of oral feeding skills in preterm infants. *Teaching and Learning in Communication Sciences & Disorders, 4*(3). https://doi.org/10.30707/TLCSD4.3/FVMX2142

Busch, C. M., & Ma, T. (2023). Speech-language pathology graduate students' perception of satisfaction, confidence, and interpersonal skill development during simulated experiences amid COVID-19. *Perspectives of the ASHA Special Interest Groups, 8*(1), 134–150. https://doi.org/10.1044/2022_PERSP-22-00073

Cantrell, M. A. (2008). The importance of debriefing in clinical simulations. *Clinical Simulation in Nursing, 4*(2), e19–e23. https://doi.org/10.1016/j.ecns.2008.06.006

Clinard, E. S. (2022). Increasing student confidence with medically complex infants through simulation: A mixed methods investigation. *American Journal of Speech-Language Pathology, 31*(2), 942–958. https://doi.org/10.1044/2021_AJSLP-21-00234

Conlon, E. L., Braun, E. J., Babbitt, E. M., & Cherney, L. R. (2020). Treatment fidelity procedures for an aphasia intervention within a randomized controlled trial: Design, feasibility, and results. *American Journal of Speech-Language Pathology, 29*(1S), 412–424. https://doi.org/10.1044/2019_AJSLP-CAC48-18-0227

Decker, S., Fey, M., Sideras, S., Caballero, S., Rockstraw, L., Boese, T., Franklin, A. E., Gloe, D., Lioce, L., Sando, C. R., Meakim, C., & Borum, J. C. (2013). Standards of best practice: Simulation standard VI: The debriefing process. *Clinical Simulation in Nursing, 9*(6), S26–S29. https://doi.org/10.1016/j.ecns.2013.04.008

Dincher, B. R., McGrath, M., & Griffith, J. (2020). Students' perspectives following involvement in a constraint induced aphasia therapy research project. *Teaching and Learning in Communication Sciences & Disorders, 4*(2), Article 2. https://doi.org/10.30707/TLCSD4.2/SMWG7415

Donaldson, A. L. (2015). Pre-professional training for serving children with ASD: An apprenticeship model of supervision. *Teacher Education and Special Education, 38*(1), 58–70. https://doi.org/10.1177/0888406414566995

Dudding, C. C., McCready, V., Nunez, L. M., & Procaccini, S. J. (2017). Clinical supervision in speech-language pathology and audiology in the United States: Development of a professional specialty. *The Clinical Supervisor, 36*(2), 161–181. https://doi.org/10.1080/07325223.2017.1377663

Dudding, C. C., & Nottingham, E. E. (2018). A national survey of simulation use in university programs in communication sciences and disorders. *American Journal of Speech-Language Pathology, 27*(1), 71–81. https://doi.org/10.1044/2017_AJSLP-17-0015

Edmonds, L. A., Mammino, K., & Ojeda, J. (2014). Effect of Verb Network Strengthening Treatment (VneST) in persons with aphasia: Extension and replication of previous findings. *American Journal of Speech-Language Pathology, 23*(2), S312–S329. https://doi.org/10.1044/2014_AJSLP-13-0098

Ferguson, N. F., & Estis, J. M. (2018). Training students to evaluate preterm infant feeding safety using a video-recorded patient simulation approach. *American Journal of Speech-Language Pathology, 27*(2), 566–573. https://doi.org/10.1044/2017_AJSLP-16-0107

Fraser, K. L., Ayres, P., & Sweller, J. (2015). Cognitive load theory for the design of medical simulations. *Simulation in Healthcare, 10*(5), 295–307. https://doi.org/10.1097/SIH.0000000000000097

Hill, A. E., Ward, E., Heard, R., McAllister, S., McCabe, P., Penman, A., Caird, E., Aldridge, D., Baldac, S., Cardell, E., Davenport, R., Davidson, B., Hewat, S., Howells, S., Purcell, A., & Walters, J. (2021). Simulation can replace part of speech-language pathology placement time: A randomised controlled trial. *International Journal of Speech-Language Pathology, 23*(1), 92–102. https://doi.org/10.1080/17549507.2020.1722238

Howells, S., Cardell, E. A., Waite, M. C., Bialocerkowski, A., & Tuttle, N. (2019). A simulation-based learning experience in augmentative and alternative communication using telepractice: Speech pathology students' confidence and perceptions. *Advances in Simulation, 4*(Suppl. 1), Article 23. https://doi.org/10.1186/s41077-019-0113-x

Issenberg, S. B., McGaghie, W. C., Petrusa, E. R., Lee Gordon, D., & Scalese, R. J. (2005). Features and uses of high-fidelity medical simulations that lead to effective learning: A BEME systematic review. *Medical Teacher, 27*(1), 10–28. https://doi.org/10.1080/01421590500046924

Kertesz, A. (2006). *Western Aphasia Battery–Revised* (WAB-R) [Database record]. APA PsycTests. https://doi.org/10.1037/t15168-000

Lenth, R. (2022). *emmeans: Estimated marginal means, aka least-squares means* (Version 1.10.0). R Foundation for Statistical Computing. https://CRAN.R-project.org/package=emmeans

Lewis, A., Rudd, C. J., & Mills, B. (2018). Working with children with autism: An interprofessional simulation-based tutorial for speech pathology and occupational therapy students. *Journal of Interprofessional Care, 32*(2), 242–244. https://doi.org/10.1080/13561820.2017.1388221

McHugh, M. L. (2012). Interrater reliability: The kappa statistic. *Biochemia Medica, 22*(3), 276–282.

Moineau, S., Bennett, D., & Scheer-Cohen, A. (2018). Aphasia simulation: A perspective from the student and standardized patient. *Teaching and Learning in Communication Sciences & Disorders, 2*(1), 1–14. https://doi.org/10.30707/tlcsd2.1moineau

Norman, G., Dore, K., & Grierson, L. (2012). The minimal relationship between simulation fidelity and transfer of learning. *Medical Education, 46*(7), 636–647. https://doi.org/10.1111/j.1365-2923.2012.04243.x

Peña, E. D., & Kiran, S. (2008). In defense of cookbooks: From novice to competent clinician. *Topics in Language Disorders, 28*(3), 242–258. https://doi.org/10.1097/01.TLD.0000333599.30468.9d

R Core Team. (2022). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.R-project.org/

Singmann, H., Bolker, B., Westfall, J., Aust, F., & Ben-Shachar, M. (2022). *afex: Analysis of factorial experiments* (Version 1.1–1). R package. https://CRAN.R-project.org/package=afex

Sweller, J., Van Merrienboer, J. J., & Paas, F. G. (1998). Cognitive architecture and instructional design. *Educational Psychology Review, 10*(3), 251–296. https://doi.org/10.1023/A:1022193728205

Thomas, D. C., Chan, A., Tudberry, N., & Purcell, A. (2023). Watch vs do: A randomized crossover design evaluating modified simulated patients and video learning for novice speech–

language therapy students. *International Journal of Language & Communication Disorders, 58*(2), 467–481. https://doi.org/10.1111/1460-6984.12808

Turkstra, L. S., Norman, R., Whyte, J., Dijkers, M. P., & Hart, T. (2016). Knowing what we're doing: Why specification of treatment methods is critical for evidence-based practice in speech-language pathology. *American Journal of Speech-Language Pathology, 25*(2), 164–171. https://doi.org/10.1044/2015_AJSLP-15-0060

Ward, E. C., Baker, S. C., Wall, L. R., Duggan, B. L., Hancock, K. L., Bassett, L. V., & Hyde, T. J. (2014). Can human mannequin-based simulation provide a feasible and clinically acceptable method for training tracheostomy management skills for speech-language pathologists? *American Journal of Speech-Language Pathology, 23*(3), 421–436. https://doi.org/10.1044/2014_AJSLP-13-0050

Ward, E. C., Hill, A. E., Nund, R. L., Rumbach, A. F., Walker-Smith, K., Wright, S. E., Kelly, K., & Dodrill P. (2015). Developing clinical skills in paediatric dysphagia management using human patient simulation (HPS). *International Journal of Speech-Language Pathology, 17*(3), 230–240. https://doi.org/10.3109/17549507.2015.1025846

Wolford, G. W., Fissel Brannick, S., Strother, S., & Wolford, L. (2021). Clinical education outcomes and research directions in speech-language pathology: A scoping review. *Teaching and Learning in Communication Sciences & Disorders, 5*(2), Article 3. https://doi.org/10.30707/TLCSD5.2.1624983591.656565

Wolford, G. W., Wash, E. J., McMillon, A. R., & LaCroix, A. N. (2023). How does training format and clinical education model impact fidelity and confidence in a speech-language pathology rotation? *Advances in Health Sciences Education: Theory and Practice*. Advance online publication. https://doi.org/10.1007/s10459-023-10276-1

Wolford, L. L., & Wolford, G. W. (2020). Comparing in vivo versus simulation training for transnasal endoscopy skills. *Teaching and Learning in Communication Sciences & Disorders, 4*(3). https://doi.org/10.30707/TLCSD4.3/WBMM3495

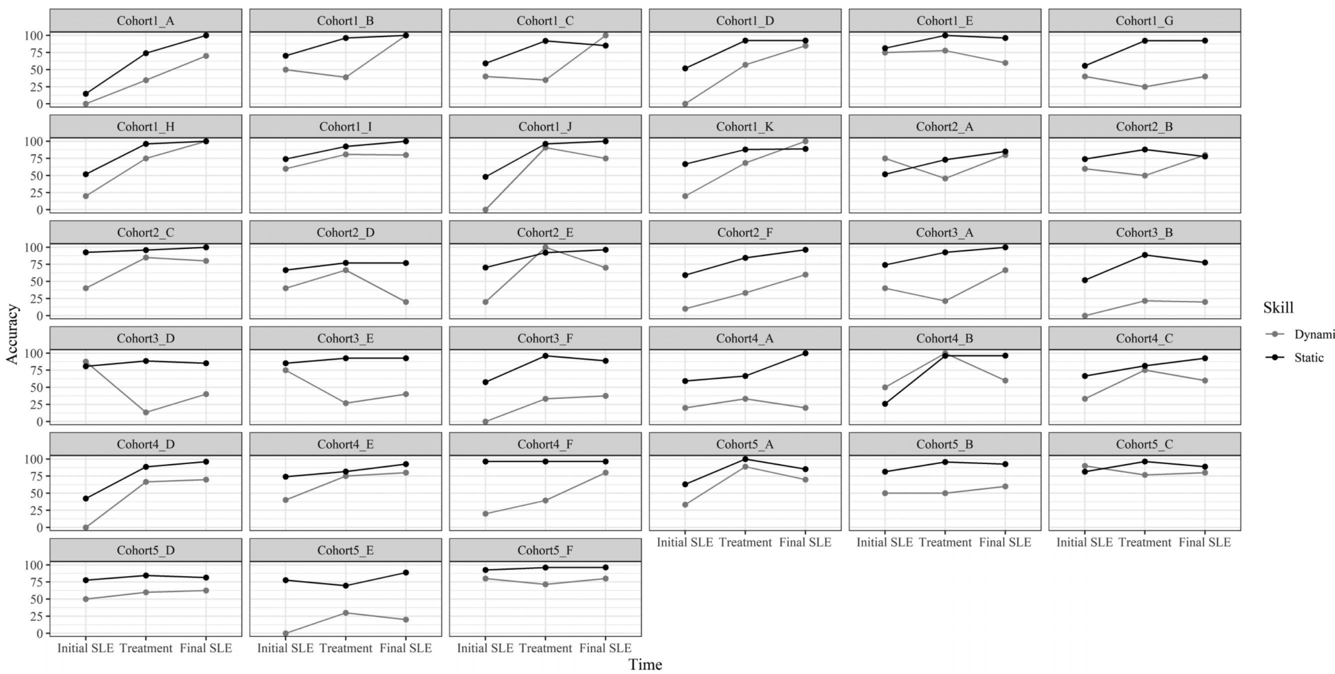
Young, J. Q., Van Merrienboer, J., Durning, S., & Ten Cate, O. (2014). Cognitive Load Theory: Implications for medical education: AMEE Guide No. 86. *Medical Teacher, 36*(5), 371–384. https://doi.org/10.3109/0142159X.2014.889290

Zraick, R. I., Allen, R. M., & Johnson, S. B. (2003). The use of standardized patients to teach and test interpersonal and communication skills with students in speech-language pathology. *Advances in Health Sciences Education, 8*(3), 237–248. https://doi.org/10.1023/A:1026015430376

Appendix A

Individual Accuracy by Time

Figure A1. The acquisition of static and dynamic skills separated by participant. Each cohort represents a group of students that completed the protocol during the same 10-week rotation. The cohorts are identified using numbers, and letters are used to indicate individual students within each cohort. Cohort 3 has the least experience; they completed the study as part of their first of four on campus clinical rotations. Cohort 2 is the most experienced group; they completed the study as part of their fourth or last on-campus clinical rotation. SLE = simulated learning experience.



Appendix B (p. 1 of 2)

Adapted VNeST Protocol

Item	Skill type	Step and description
		Step 1: Generate of Agent + Verb + Patient Triads:
1	S	Write, who, what, and the target verb
2	S	1st Who: Clinician places verb and asks, "Who can verb (something/someone)?"
3	D	[a]Semantic Cueing: *Provide semantic cueing hierarchy as needed*
4*	S	1st What: Clinician asks "What does a *subject + verb*"
5*	D	[a]Semantic Cueing: *Provide semantic cueing hierarchy as needed*
6	S	1st Read: Clinician instructs participant to read triad aloud
7*	S	2nd Who: Clinician places verb and asks, "Who can verb (something/someone)?"
8*	D	[a]Semantic Cueing: *Provide semantic cueing hierarchy as needed*
9	S	2nd What: Clinician asks "What does a *subject + verb*"
10	D	[a]Semantic Cueing: *Provide semantic cueing hierarchy as needed*
11	S	2nd Read: Clinician instructs participant to read triad aloud
12	S	3rd Who: Clinician places verb and asks, "Who can verb (something/someone)?"
13	D	[a]Semantic Cueing: *Provide semantic cueing hierarchy as needed*
14	S	3rd What: Clinician asks "What does a *subject + verb*"
15	D	[a]Semantic Cueing: *Provide semantic cueing hierarchy as needed*
16	S	3rd Read: Clinician instructs participant to read triad aloud
17	S	4th Who: Clinician places verb and asks, "Who can verb (something/someone)?"
18	D	[a]Semantic Cueing: *Provide semantic cueing hierarchy as needed*
19	S	4th What: Clinician asks "What does a *subject + verb*"
20	D	[a]Semantic Cueing: *Provide semantic cueing hierarchy as needed*
21	S	4th Read: Clinician instructs participant to read triad aloud
		Step 2: Reading triads
22	S	Participant reads all triads aloud
23	D	[b]Choral Reading Hierarchy: *Provide choral reading hierarchy as needed*
		Step 3: Wh- Questions from a triad
24	S	Clinician requests participant choose SVO triad to expand
25	S	Clinician writes out Where When Why slots in correct order
26*	S	S3 Where: Clinician elicits where to expand the triad
27*	D	[a]Semantic Cueing: *Provide semantic cueing hierarchy as needed*
28	S	1st Read: Clinician instructs participant to read expanded triad aloud
29	D	[b]Choral Reading Hierarchy: *Provide choral reading hierarchy as needed*
30	S	S3 When: Clinician elicits when to expand the triad
31	D	[a]Semantic Cueing: *Provide semantic cueing hierarchy as needed*
32	S	2nd Read: Clinician instructs participant to read expanded triad aloud
33	D	[b]Choral Reading Hierarchy: *Provide choral reading hierarchy as needed*
34	S	S3 Why Clinician elicits why to expand the triad
35	D	[a]Semantic Cueing: *Provide semantic cueing hierarchy as needed*
36*	S	3rd Read: Clinician instructs participant to read expanded triad aloud
37*	D	[b]Choral Reading Hierarchy: *Provide choral reading hierarchy as needed*
		Step 4: Semantic Judgments
38	S	3 Correct sentences presented or answered
39*	S	3 Sentences with incorrect subjects presented or answered
40	S	3 Sentences with incorrect objects presented or answered
41	S	3 Sentences with semantic reversals or answered
42*	D	[c]Judgment Cueing Hierarchy: *Provide reading cueing hierarchy as needed*

(*table continues*)

Appendix B (p. 2 of 2)

Adapted VNeST Protocol

Item	Skill type	Step and description
		Step 5: Verb elicitation
43*	S	Clinician asks, “What verb have we been working on?”
44*	D	[a]Semantic Cueing: *Provide semantic cueing hierarchy as needed*
		Step 6: SVO triads/sentence generated
45*	S	Triad Start: Clinician asks the client for who and what does the verb
46	S	Triad Complete: After client gets the subject or object, clinician prompts the client for a complete sentence
47*	D	[a]Semantic Cueing: *Provide semantic cueing hierarchy as needed*

Note. The Verb Network Strengthening Treatment (VNeST) fidelity protocol was adapted from Conlon et al. (2020), p. 423. Each specific action that a clinician takes is described as an “Item” and groups of items are “Steps.” “S” indicates a static skill, and “D” indicates a dynamic skill. Items 1, 23, 25, 29, 32, 33, and 37 were excluded from the analyses to equate scoring across the simulated learning experiences and treatment time points.

[a]The semantic cueing hierarchy progresses from minimum to maximum cueing. A minimum cue is a semantic cue, and a maximum cue is four written choices (one target, three related foils). [b]The choral reading hierarchy progresses from minimum to maximum cueing. A minimum cue consists of a direct model, and a maximum cue is choral production of the triad. [c]The judgment cueing hierarchy progresses from minimum to maximum cueing. A minimum cue consists of the clinician re-reading the sentence. A maximum cue is re-reading the sentence a second time placing emphasis on the incorrect agent or patient. The judgment cueing hierarchies could occur up to 12 times during treatment (once per sentence) but only occurred once in the simulations.

*Indicates a planned error in the simulation protocol that was designed to elicit maximum prompting on the dynamic items.

Appendix C

Completed VNeST Digital Shell Example

An example, using the verb "bake," of the PowerPoint shell students had access to during treatment for Step 1 (A) and Step 3 (B). Printed words were provided as part of the PowerPoint shell while words written in cursive represent client generated responses.