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Student Navigation Through Computer-Based Simulations: What Predicts Success?

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Simulations have become an increasingly utilized resource for educating students in the healthcare arena and within graduate programs in communication sciences and disorders (Hill et al., 2021). Macbean and colleagues (2013) noted clinical simulations offer a viable educational tool, allowing CSD students to develop clinical skills and competencies. Aliner (2011) reported simulations offer exposure to a wider range of clinical scenarios, which can include rare/low incidence populations. Simulations provide consistent clinical experiences within the scenario that all students can complete. An additional, documented benefit of simulations that they offer a controlled learning environment that provides safety to learners and patients. Simulations allow the learner to make mistakes and learn from them without harming a patient (Aliner, 2007; Issenberg & Scalese, 2007; Quail et al., 2016). Currently, programs approach their integration of simulation into curriculum in various ways for myriad purposes. This challenge makes it essential to understand how students move through the simulations and what internal factors inherent to the simulation contribute to overall success. It is this understanding that can assist faculty in supporting students in their exploration of simulations and meeting the objectives critical for clinical skill development. The purpose of this paper is to review the use of simulation broadly, use of computer-based simulations specifically, and examine data on what elements of a computer-based simulation engagement predicted a student's ability to make the correct recommendation for patient care at the end of a Simucase assessment. The outcomes of this data analysis will be used to make recommendations for implementation strategies for computer-based simulation pedagogy.

Simulation Background

Graduate programs are responsible for providing opportunities for all graduates to attain the necessary knowledge and skills for clinical practice across a diverse discipline (Council on Academic Accreditation in Audiology and Speech-Language Pathology [CAA], 2018). Due in part to these challenges, the Council for Clinical Certification (CFCC) updated the certification standards in 2016 to permit inclusion of up to 75 clinical contact hours acquired through clinical simulation methods (ASHA, 2016). As programs confront increased challenges to provide high-quality and diverse clinical education, simulations offer the opportunity to assess students' clinical skills while providing equity and consistency for student clinical training (Aliner, 2007; Issenberg & Scalese, 2007; Quail et al., 2016).

Dudding and Nottingham (2018) surveyed CSD programs for their usage of simulation. The perceived benefits of simulations for CSD were numerous and included (a) increased student confidence, (b) repeated practice in a safe environment, (c) access to a broader range of experiences and client types, (d) benefits in preparing students for off-campus placements, (e) bridging the gap between knowledge acquired in the classroom and clinical skill areas, and (f) potential uses for remediation. In 2019, the Council of Academic Programs in CSD (CAPCSD) issued a white paper to give a broad review of simulation technologies, programs, and processes to offer CSD graduate programs an overview of evidence, best practice, implementation, and evaluation processes (Dudding et al., 2019). Five primary modes of simulation used in healthcare training emerged across disciplines:

- **standardized patients**: a person simulates an actual patient in a standardized repeatable way.
- **task trainers**: a device that trains a particular skill.
- **mannequins**: a human-like simulator to mimic human functions.

- **computer-based simulation**: a computer-based technology often utilizing gaming technology and augmented reality.
- **immersive virtual reality**: a computer-based, three-dimensional space for immersive learning (Dudding et al, 2019).

More specifically, computer-based simulations for clinical training are designed to mimic real clinical situations while confined to a computer or other assistive devices (Dudding et al., 2019). These simulations are designed for participants to make clinical choices in a clinical scenario. One advantage of computer-based simulations is that learners can start and restart the simulation while receiving feedback about performance, thereby allowing students to change their approach. Furthermore, students are able to maintain a higher level of autonomy to self-direct their own learning (Winters et al., 2008). Through repeated low-stakes trials, students can interact with virtual patients without punitive consequences. Computer-based simulations can include interprofessional contact, develop assessment skills, simulate interventions, or support skilled fluency development (Dudding et al., 2019).

Computer-Based Simulation

Research shows that using computer-based simulation to monitor the emergence of clinical comprehension and activate previously held knowledge facilitates a deeper understanding of the clinical process. This process is enhanced by receiving continuous feedback (Van der Kleij et al., 2015). When simulation is paired with feedback, supervision outcomes are often improved (Fanning and Gaba, 2007; McGaghie et al., 2009). Following the completion of a computer-based simulation, best practice suggests that a knowledgeable facilitator should provide students with an opportunity to answer self-reflective and applied questions related to their simulation. This experience, known as a debrief, supports students in reflecting on how the simulation can apply to real patients and clinical scenarios (Gardner, 2013; Fanning and Gaba, 2007; Dufrene and Young, 2013; Dudding et al., 2019). This component allows students and instructors alike to reflect on the lessons learned during the simulation and establish learning objectives and outcomes obtained through the experience (Mattila et al., 2020).

Simucase. Dudding and Nottingham (2018) found 31 out of 69 surveyed universities using simulations utilize computer-based methods. The authors speculated this may be due to the popular, commercially available program Simucase. This number is likely higher today due to the rapid increase of simulation use following the onset of COVID-19 in Spring 2020. Simucase is a computer-based simulation program designed for students to collect information relevant to the client and the disorder, select and administer assessments based on a clinical hypothesis, critically analyze assessment results to determine diagnostic findings, and formulate recommendations to support an evidence-based treatment plan for virtual patients. As a student completes portions of the case, more information on the patient becomes available, thus forcing the learner to adapt and adjust to feedback (Ondo et al., 2020). These simulation scenarios also provide students with the opportunity for interprofessional education. Students are able to practice communicating with a collaborative care team, thereby improving their interprofessional competencies. Simucase provides opportunities for students to interact with virtual patients to make assessment and intervention decisions in a risk-free environment under controlled conditions (Jansen, 2015).

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One strength of Simucase is the program's ability to allow users to thoroughly explore the patient's background through case history and communication with collaborators. Patient interviews and gathering background information have both been shown to be critical components of quality patient care. Reviewing and obtaining an accurate patient history and medical background is vital to arriving at a correct diagnosis and ultimately managing the medical condition (Rahmna & Tasmin, 2007; Berman & Chutku, 2016). Lichstein (1990) noted that often the most complicated diagnostic puzzles are unraveled through the patient-centered interview and background information review. Simucase achieves this through a case history section that typically contains the patient referral information as well as a patient interview or introduction. Students have the opportunity to interact with the patient either through video or avatar and explore common areas of case history, including (a) family information, (b) areas of concern, (c) developmental background, (d) hearing and vision, (e) medical background, (f) feeding and swallowing, (g) speech, fluency, and voice, (h) language and literacy, (i) social behavioral, and (j) education and work history. Depending on the case, not all case history areas are relevant, and students are expected to use their emerging clinical skills to determine which case history areas to explore. The collaborators section provides an additional area of background information available to students in Simucase. Within this section, students have the ability to question medical, family, or education collaborators who may be involved with the patient. This section allows students to gain crucial information for case success and develop interprofessional skills. As with the case history section, students are expected to ask questions appropriate to the particular case only.

With the rise of computer-based education, several studies have investigated using Simucase simulation for clinically training students. A study by Mattila and colleagues (2020) found that occupational therapy students who engaged in a one-week clinical rotation using Simucase demonstrated development of enhanced in-depth reflections, clinical reasoning, and clinical abilities. This experience was implemented as a response to the loss of in-person clinical rotations following the onset of the COVID-19 pandemic. Students also reported an overall positive perception of the simulated rotation and the opportunity to engage with low-incidence patients in a low-stakes environment (Mattila et al., 2020). Similarly, a study by Carter (2019) found students who were engaged in computer-based simulations outperformed the traditional learning group on clinical-based outcomes. A white paper by Flynn and colleagues (2015) described using Simucase within their speech-language pathology assistant (SLPA) program. Students within the program reported that one benefit to using the simulations was the opportunity to work and rework the cases to explore different treatment and assessment methods.

Overall, students reported satisfaction and increased learning through the computer-based simulation diagnostic practicum in most investigative studies. However, one reported limitation of the study the authors acknowledged was the varied and inconsistent use of prebrief and debrief discussions across the courses in which they were implemented (Flynn et al., 2015). Additionally, Clinard and Dudding (2019) investigated perceptions of computer-based simulations (i.e., Simucase) with students engaged in focus groups throughout a semester-long simulated diagnostics practicum. Some reported challenges to this experience were difficulties with learning and navigating the Simucase program, receiving limited feedback, and challenges with expectations. A mentioned weakness of the student experience was the “game-mentality,” where students commented on their limited understanding of “what the system wanted,” and that the simulations became too easy over time.

Therefore, a primary challenge with implementing simulations into clinical programs and measuring their effectiveness is the wide range of application practices. Dudding and colleagues (2018) suggested that using best-practice pedagogy is essential for simulations to have their desired outcomes on learning. Although it is unknown how many programs are implementing Simucase simulations in totality and how their pedagogy implementations compare, it can be assumed that programs approach their integration into curriculum in a variety of ways to meet different program and course objectives. Understanding what internal factors in the simulations contribute to overall success can aid faculty in supporting students in their exploration of computer-based simulations such as Simucase for the purpose of clinical skill development.

Purpose

This study analyzed student decisions within a computer-based diagnostic simulation (Simucase) from 149 students at the graduate level. The purpose of this study is to explore which variables predicted student success on the computer-based simulation. Driving questions for this research included:

1. What factors predict student success on the computer-based diagnostic simulation?
2. What differences exist in case exploration between students who get the care recommendation correct and those that do not?

Method

Sample. The data set used for this study included 149 graduate students. These graduate students were from CSD programs across the United States. Participant reports were de-identified for the purpose of this study. Age, prior coursework, and clinical experiences for participants were unknown as the participants were from more than one university and analysis was completed post-hoc. Participants were chosen at random from a database of completed submissions for the simulation client, "Robert." Completed submissions were defined as submissions that had saved activity in all sections of the simulation and a final recommendation submitted. Only first-attempt trials were used for data analysis, meaning each attempt at the case was the student's first. The selected Robert case depicts a one-year post-stroke patient interested in starting therapy at the outpatient clinic close to his home. All participants used in this study completed Robert's simulation with saved activity in all sections and a final recommendation submitted. The Robert simulation was selected because of its relatively widely used application across programs in the United States. Individual student trials on the case were compared against the *Master Key* developed by Simucase for the simulation.

Predictors. The elements of the predictive metrics were the total number of total possible points per Simucase section. These include case history, collaborators, assessment, and diagnosis. Each predictor variable had three possible outcomes:

- **reflective**: necessary and/or accurate choice.
- **acceptable**: neutral choice (good to know but not necessary for case success).
- **rejected**: irrelevant and/or inaccurate choice.

Simucase also awards a penalty score if a student administers an assessment that is redundant to one already chosen. When this occurs, the first-choice assessment is awarded as the reflective outcome and the redundant choice is scored as rejected. An example is the dual administration of two comprehensive aphasia batteries within the Robert case. Totaling the possible scores (e.g., reflective, acceptable, rejected) for decisions within each section (e.g., case history, collaborators, assessment, diagnosis) yielded 12 variables that were analyzed.

Outcome Measures. The recommendations section was used as the case outcome variable (reflective/rejected). The recommendations section had five possible options, with one being the reflective (correct) recommendation. Recommendation options were as follows:

1. Robert qualifies for outpatient services. Recommend individual therapy focused on auditory and reading comprehension, word finding for functional vocabulary, self-monitoring for reduction of jargon, and trial use of augmentative and alternative communication (AAC) device in therapy. Recommend client and family education. (Correct/Reflective).
2. Robert qualifies for outpatient services. Recommend individual therapy to target memory and executive function deficits. Recommend use of compensatory strategies. (Incorrect/Reject).
3. Robert qualifies for outpatient services. Recommend individual and group therapy. Treatment should focus on improving verbal expression by repeating phrases and series of words for increased participation in his daily life and interests. Recommend client and family education. (Incorrect/Reject).
4. Robert qualifies for outpatient services. Recommend individual therapy. Treatment should focus on improving dysarthria. Recommend client and family education. (Incorrect/Reject).
5. Robert does not qualify for outpatient services. Recommend family purchases a tablet device for assistance with communication. (Incorrect/Reject).

Analyses. To determine which areas of the simulation were predicting variables, a standard binary logistic regression was performed to determine if the 12 areas of the case (e.g., case history reflective, case history acceptable, case history reject, collaborators reflective, collaborators acceptable, etc.) would be predictive of making a correct versus incorrect recommendation based on the case simulation. First, the model as a whole (i.e., combination of predictors) was tested using a chi-square goodness of fit test. Further, each individual predictor's unique contribution to the model was tested using the Wald chi-square test. The logistic regression also yielded parameter estimates (*B*, in log-odds units) for each predictor, as well as the odds ratio which is a more interpretable measure of association. Additionally, independent sample t-tests were conducted to evaluate group difference on performance for each predictor.

Results

Prior to evaluating the regression model, multicollinearity was assessed; there was no excessive overlap among the 12 predictors as all tolerance statistics were greater than 0.10. Based on standardized residuals, there was one outlier identified (i.e., $z = -3.47$); based on Cook's distance (D) values that were greater than 1.0, there were four influential cases identified. These cases were retained in the data and included in a test of the model reported below.

A test of the full model with all 12 predictors against a constant-only (or null) model was statistically significant, χ^2 $(12, N = 149) = 104.20$, $p < .001$, indicating the predictors, as a set, reliably distinguished between those making an accurate versus inaccurate recommendation. The variance accounted for in the binary outcome based on the Cox and Snell R^2 (R_{CS}^2) and the Nagelkerke R^2 (R_N^2) was 0.50 and 0.67 respectively. The model's prediction success rate was as follows: 77.3% of cases whose recommendation was incorrect were correctly predicted, and 92.8% of cases whose recommendation was correct were correctly predicted, for an overall success rate of 85.9%.

Table 1 shows regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for odds ratios for each of the 12 predictors. According to the Wald criterion, four predictors were significant when alpha was set to 0.05. The odds of getting the recommendation correct increased as scores on the case history-acceptable and collaborator-acceptable metrics increased, whereas the odds of getting the recommendation correct decreased as scores on the case history-reflective and diagnosis-rejected metrics increased.

Independent sample t-tests were conducted to compare group performance on each of the 12 predictor variables. Students who chose the reflective (correct) recommendation were compared against students who chose the rejected (incorrect) recommendation at the end of the case. Results of these tests reveal that group differences exist in nine of the twelve areas where students make decisions. This result means that students who ultimately chose the accurate recommendation at the end of the case significantly differed from the group who did not make the accurate recommendation in most case areas including all areas of the case history and diagnoses sections, rejected collaborators and assessment, and reflective assessment. See full results in Table 2.

Discussion

The first goal of this study was to identify which factors predicted student success on a Simucase computer-based simulation. Results indicated that student patterns of Simucase engagement predict overall case success. The model with all 12 predictors was significant, which indicated that by looking at student engagement in the case, it can be determined which student will choose the correct outcome and which will not with relatively good efficacy. As previously mentioned, "student engagement" was defined as students making selections from within the section. Within the model, four of the predictors were significant, indicating they supplied the biggest contribution to the model.

This study revealed students who engage in more careful navigation of the case history and collaborator sections of the computer-based simulation are more likely to reach the correct recommendation at the end of the case. This result has clinical implications for using computer-based simulators, specifically Simucase, for clinical teaching purposes. The seminal reviews by Fanning and Gaba (2007) sought to critically explore the role of debriefing in simulation-based learning. Debriefing as a teaching tool, sets to make learners active participants in their learning while ensuring that simulation learning objectives are met. Debriefing allows for instructors to examine learner performance in relationship to objectives and bridge any gaps that remain between performance and target (Fanning & Gaba, 2007).

Table 1
Logistic Regression Analysis of Recommendation as a Function of Metric Variables

				95% Confidence Interval for Odds Ratio	
Predictor	*B*	Wald's χ^2	*OR*	*LL*	*UL*
Constant	-3.49	4.15	--	--	--
Case History: Acceptable	.50	14.04*	1.65	1.27	2.15
Case History: Reflective	-.32	5.70*	0.72	0.56	0.94
Case History: Rejected	.44	0.94	1.55	0.64	3.74
Collaborator: Reflective	-.14	3.33	0.87	0.75	1.01
Collaborator: Acceptable	.25	10.48*	1.28	1.10	1.48
Collaborator: Rejected	-.13	0.42	0.88	0.60	1.29
Assessment: Reflective	-.07	0.30	0.93	0.73	1.20
Assessment: Acceptable	.63	2.95	1.87	0.92	3.82
Assessment: Rejected	-.23	1.25	0.79	0.53	1.19
Diagnosis: Reflective	.13	0.29	1.14	0.71	1.84
Diagnosis: Acceptable	.57	1.86	1.77	0.78	4.03
Diagnosis: Rejected	-.97	6.75*	0.38	0.18	0.79

* $p < .05$

Table 2
Group difference in case engagement for predictor variables

	Number of Reflective Choices Made M (SD)	Number of Acceptable Choices Made M (SD)	Number of Rejected Cases Made M (SD)
Case History Total	2.36 (3.61)	3.87 (4.82)	0.95 (2.6)
Reflective Recommendation	3.28 (4.49)	2.51 (1.69)	0.48 (1.48)
Rejected Recommendation	1.21 (1.38)	5.58 (6.63)	1.30 (2.50)
Group Difference *p* (two-tailed)	< 0.00*	< 0.00*	< 0.05*
Collaborators Total	15.38 (4.63)	16.77 (5.90)	2.09 (4.76)
Reflective Recommendation	15.34 (5.62)	16.54 (3.87)	1.01 (1.63)
Rejected Recommendation	15.44 (3.00)	17.06 (7.76)	3.44 (6.71)
Group Difference *p* (two-tailed)	< 0.89	< 0.59	< 0.00**
Assessment Total	5.02 (3.80)	3.25 (0.89)	2.91 (3.59)
Reflective Recommendation	4.01 (2.85)	3.30 (0.82)	1.73 (1.48)
Rejected Recommendation	6.29 (4.44)	3.18 (0.98)	4.38 (4.75)
Group Difference *p* (two-tailed)	< 0.00**	< 0.42	< 0.00**
Diagnosis Total	1.48 (1.39)	2.54 (0.71)	3.27 (9.31)
Reflective Recommendation	1.20 (1.25)	2.67 (0.61)	0.31 (0.75)
Rejected Recommendation	1.83 (1.49)	2.38 (0.80)	6.98 (13.10)
Group Difference *p* (two-tailed)	< 0.01**	< 0.01**	< 0.00**

* $p < .05$, ** $p < .01$

In the fields of CSD, Dudding and colleagues (2019) advocated for a three-phase approach to using simulations (a) prebriefing, (b) the simulation experience, and (c) debriefing. Prebriefing provides orientation to the simulation and clarity on objectives, expectations, roles, and assessment. Debriefing immediately after the simulation offers an opportunity for additional feedback, reflection, and reconnection to the learning objectives and big-picture of clinical practice, an essential component of student learning in simulations. This step is particularly important to connect simulated learning to real-life clinical practice. Gaba (2007) indicated that skills in patient-client and co-worker communication, and hazardous procedures that require experience can be useful outcomes for healthcare simulation.

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Because results of this study indicate that early case portions (i.e. case history and collaborators) are critical to case success classroom teaching can provide an increased focus on early steps in client case management, such as close examination of case history and collaborator information, to support students' development of clinical processes. Prebrief procedures can direct students to focus their attention on important aspects of clinical thinking as they relate to patient interviews and collaboration with outside professionals and family members, knowing that these steps are critical to case outcomes (Dudding et al., 2019). Because the purpose of the simulation is to replicate a typical assessment process that would be seen in a clinical environment, helping students to draw connections between the importance of completing a thorough case history and targeted collaboration with other professionals is essential to their future clinical practice.

The study's second goal was to examine what differences exist in case exploration between students who choose the correct case recommendation and those who do not. The two groups differed on their engagement with the case in 9 of the 12 predictors examined for the study. Students who ultimately chose the wrong case recommendation made more rejected decisions on every case component than the group who ultimately chose the correct recommendation. On an individual level, students also demonstrated a wide range of variability in their exploration of the computer-based simulation as demonstrated by the wide range of standard deviations. This variability means students were able to arrive at the correct case recommendation through many pathways. From a pedagogical standpoint, this result may be troubling, because if faculty are using correct recommendations as a measurement of success on the simulation experience, they are likely missing a great deal of performance variance in their students. Arriving at the correct recommendation may not be a good indicator of clinical knowledge or process; therefore, faculty must examine performance in each section to truly understand a student's clinical thought processes and review the decisions with a student during a debrief. Each of the predictor variables will be discussed separately.

As students increased their score on acceptable case history and collaborators, it increased the odds that the student would reach the correct recommendation at the end of the case. This outcome is further reinforced by the data showing a significant difference between the groups, with students from the correct recommendation group asking significantly more acceptable questions within the case history portion of the simulation. This pattern is reinforced by literature indicating that time spent on patient background and interview leads to better patient care (Rahmna & Tasmin, 2007; Berman & Chutku, 2016). Student engagement in the case history, defined as students choosing selections from within the section, likely indicates a deeper exploration of the patient's background. Acceptable questions on the Simucase platform were questions that were not essential to the case but could be additive to case background information. These questions were considered neutral in terms of scoring. Patient and family interviews represent the foundational first step in patient care, and the model indicated time spent asking questions about case history increases the student's likelihood of making the correct recommendation at the end of the case.

Additionally, as students increased their scores on the collaborators-acceptable, it increased their odds of achieving the correct recommendation at the simulation's end. Individual t-tests also indicated a significant difference between groups where students who ultimately made an incorrect recommendation were more likely to ask rejected collaborator questions. Consulting with collaborators and examining their reports on the patient also represented an initial step in patient care. Caldwell (2019) posited that clinical consultations are essential during the patient diagnostic process to reduce the rates of misdiagnoses and increase both patient outcomes and experiences. As with a poor patient interview, poor collaboration can lead to an increased likelihood of incorrect diagnosis (Caldwell, 2019; Lichstein; 1990). Students who ultimately chose the wrong case recommendation also chose significantly more rejected collaborators within the case. This pattern could be an indication that for these students, they lacked a fundamental understanding and/or exposure to interprofessional roles and responsibilities. These students may benefit from increased interprofessional education (IPE) to increase their odds of engaging with appropriate professionals in the future. Systematic reviews by Reeves and colleagues (2016; 2017) found that IPE improves participant attitudes, perceptions, knowledge and skills as they relate to collaboration and understanding of ancillary work with professional colleagues. For example, within the Robert case, students could interact with eight different collaborators to help them gather information about the patient. Table 3 details these collaborators and their scoring for the case. Students who did not grasp how the relationship Robert's primary caregiver (Wife) has to the patient can offer greater insight to the issue at hand than someone like Robert's daughter or son—who are not primary caregivers—may also struggle to choose appropriate professionals without more guidance about leveraging the information the correct professional can provide. Furthermore, IPE activities conducted through simulation could support bridging the gap between knowledge and comfort and authentic interprofessional practice skills (Weir-Mayta et al., 2020).

Analyzing the case history and collaborator interviews further supported the importance of the primary caregiver interview. The more reflective case history questions that a student asked decreased the odds they would choose the correct recommendation at the end of the case. One explanation for this outcome was that the patient featured in this case has a difficult time with open-ended questions, so asking more reflective questions is not necessarily a good outcome due to the patient's communication profile. Instead, the patient's largely unintelligible answers should cue the student to ask the caregiver for more detailed information; so in this case, the best place to gather information about the patient would be talking with his wife.

Another explanation for this result may be due to students spending more time in the area of case history overall and choosing to select all available questions regardless of appropriateness. Group differences indicate students who chose more acceptable case history questions also chose significantly more rejected case history questions, thus indicating they may not have been carefully choosing case history questions or using clinical reasoning, but rather selecting every item available within the simulation. One weakness of computer-based simulations that Clinard and Dudding (2018) reported is students can have a "game-mentality" and may become overly focused on what the computer wants to be accurate. Students can solely focus on the final score and miss the purpose of the simulation experience. Simucase supplies completion visuals to let students know how many accurate choices they have made within a case section. When students become more focused on completing the case as an assignment or for a grade, it may be that students lose focus on their clinical thinking and make choices less aligned with patient outcomes and more aligned with grade attainment.

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Table 3
Available collaborators within Simucase aphasia assessment simulation

	Rationale for Scoring	Example of Question to Collaborator
Reflective Collaborator		
· Wife	Currently the patient's primary caregiver	Tell me about your family and who Bob communicates with often.
· Audiologist	Under current care of Audiologist for hearing loss	Describe Robert's hearing loss.
Acceptable Collaborator		
· Physician	This information is already available in the patient case history	When was Robert's stroke?
· Daughter	Not a primary caregiver	Describe your dad's support system.
· Son	Not a primary caregiver	How often do you visit your mom and dad?
· Physical Therapist	Has not seen the patient for 1 year	Is Robert a fall risk?
Rejected Collaborator		
· Pediatrician	Inappropriate, as the patient is an adult	Is Robert a patient at your practice?
·Activities Coordinator at Skilled-Nursing	Inappropriate, patient is not in skilled-nursing facility	Is Robert a resident at your facility?

Setting clear expectations during a prebrief, providing feedback opportunities during the simulation, and conducting a thorough debrief are ways to encourage students to remember to keep the big-picture of clinical practice and purpose of the simulation experience (Dudding et al., 2019; Fanning & Gaba 2007). Another way to mitigate the "game-mentality" is through offering simulation activities that are non-graded to develop clinical skills. These activities could reduce anxiety about performance and allow learners to focus on skill development (Stead et al., 2020).

Finally, the likelihood of choosing the correct recommendation at the end of the case also decreased with the more diagnostic-rejected choices a student made. This result seemed to align with typical clinical practice. If a clinician does not identify the correct diagnosis of the patient, they are unlikely to make the correct recommendation (Committee on Diagnostic Error in Health Care, 2015). Across all three scoring categories (reflective, acceptable, rejected), groups were significantly different in their diagnoses selection. Although students who chose the wrong recommendations at the end of the case chose more reflective diagnoses, they also chose fewer acceptable ones and far more rejected diagnoses. A common error in the trials was that students consistently diagnosed the patient with a cognitive impairment despite no evidence to support the diagnosis. This result reiterated the importance of reviewing student reports and discussing misdiagnoses during the debrief discussion. Reviewing decisions made and areas where students made errors within the simulation can offer instructors information about where to reinforce their curriculum (Fanning & Gaba, 2007).

Limitations and Future Directions

One limitation of this study was the sparse information about individual student demographics attached to any one student attempt on the case. Additional information on student characteristics or the context in which they completed the computer-based simulation may help identify other outside factors influencing performance. Factors such as prebrief and debrief practices, coursework that has been completed, and prior clinical experiences likely contribute to student's performance on a simulation. A future direction would be to establish a standardized process for prebrief and debrief procedures for all participants. Additionally, it is also unclear if the predictive model of the Robert case would extend to other Simucase simulations or other simulation experiences. A future direction could be to apply this predictive model to additional computer-based simulations as well as other simulation modalities.

Conclusions and Clinical Implications

Simulated learning environments continue to be a positive innovation in the arena of clinical education. Computer-based simulations can offer solutions to the challenges of traditional paper-based case studies and standardized patients as well as offer exposure to patients to whom students otherwise would not have exposure (Carter, 2019; Dudding et al., 2019). Predicting student success on a computer-based simulation through error analysis is a data-driven strategy that can be used to improve the efficacy of clinical education. Within the current study, students reached recommendations in a variety of ways so without close examination of a student's trial, faculty may miss gaps in clinical understanding or decision making. As with clinical practice research that indicates the criticality of a thorough patient intake and history, this computer-based simulation study also suggested that careful navigation of early case sections such as case history and collaborators may lead to students' correct recommendation at the end of a case. Faculty can therefore emphasize the best practice of conducting a detailed interview during simulation experiences and effective collaboration with interprofessional colleagues and family members. Predicting success and recognizing patterns that can lead to incorrect recommendation selections provides powerful information that faculty can use to strengthen the prebrief and debrief discussions. Using predictive analysis to identify errors completed early on in a simulation creates an opportunity for feedback to occur within the simulation experience, and potential for reflective learning to occur, which ultimately leads to improved patient care.

DISCLOSURES

Amanda Stead, Ph.D., CCC-SLP

- Financial - Is an employee of Pacific University and receives a salary as part of the position and is currently on a 3-year funded endowed professorship studying the implementation of simulation practices within the program
- Non-Financial - Is a reviewer for TLCSD

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Paul Michael, Ph.D.

- Financial - Is an employee of Pacific University and receives a salary as part of the position
- Non-Financial - None

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