did not analyze previous clinical experience in the targeted clinical area. Therefore, students' developing skills or previous clinical experiences may have influenced the group effect.

This study offers compelling evidence that students can learn clinical competencies through simulations due to its thorough methodology, use of a standardized outcome tool, and appropriately employed statistical analysis.

Mixed Design Study

Carter (2019) investigated student learning outcomes from a computer-based simulated learning experience. Four consecutive student cohorts were randomly assigned to either a traditional learning experience or a computer-based simulation experience for a mandatory course. Appropriate statistical analyses of pre-experimental and post-experimental measures revealed that the students in the simulation group demonstrated greater improvements in various clinical skills than the traditional learning experience group.

A strength of this study is that traditional cohorts and simulation cohorts were highly equivalent at baseline. Equivalence was determined based on statistical analysis of undergraduate GPA and entrance exam scores, which are appropriate predictors for potential performance in the course. One way ANOVA of the pre-experimental measure further corroborated equivalence between the groups. Therefore, significant group effects are less likely to be attributed to participant factors. The learning conditions were also equivalent in topic, structure and depth, but the extra time devoted outside of class in the traditional condition may account for the results.

The pre-experimental and post-experimental measures are unstandardized measures, which limits the confidence that improvements are associated with empirical measures of clinical improvement. Another limitation is that the author taught the course and could not be blinded to each cohort's group assignment, which introduces potential bias. To minimize the influence of these limitations, blind raters with high inter-rater reliability and parallel forms of the pre-experimental and post-experimental measures were employed.

Although the study used non-standardized measures that reduce the clinical validity of the study, it offers suggestive evidence for the benefit of simulations due to the comprehensive methodology.

Repeated Measures Cohort Studies

Howells et al. (2019) investigated student's perceptions of confidence, preparedness to work with adults requiring alternative and augmentative communication (AAC) devices, and views on the use of telepractice and simulation before and after working with simulated patients. Two consecutive student cohorts worked with simulated patients who portrayed an adult with complex communication needs requiring an AAC device via videoconferencing. Appropriate statistical analyses revealed that student confidence significantly increased, they felt better prepared to work with this population, but had unfavorable views of telepractice. Additionally, students reported an overall positive experience and felt the simulation benefitted their clinical competence.

Strengths of this study include the use of validated and reliable tools to assess outcomes. However, measures included in this study are perception-based and consequently, offer no assessment of student skill attainment. As such, student perceptions of improvement cannot indicate an actual change in competency. Furthermore, no follow-up measures were performed to confirm if skills acquired during simulation translated to real-life clinical scenarios. The authors also neglected to investigate students' perceptions of telepractice and evaluate possible sociodemographic implications in relation to telepractice. Additionally, data was collected from a small sample of students at one academic institution, limiting the statistical power of the findings.

Overall, this study provides suggestive evidence for the use of simulation and telepractice to develop clinical skills in AAC. However, the aforementioned weakness in methodology limits the interpretation of the results.

Miles et al. (2015) explored students' perceptions of confidence, hospital readiness, and knowledge before and after participating in simulation-based training on dysphagia management. Students' perception of the simulation and post-training 0 G[(im)-3(p0 1 72.0912 0 612 792 reA-

knowledge following training was investigated as well. Students participated in two-half day training simulations, which included part-task skill learning and immersive simulated scenarios. Prior to and immediately following the simulation, students completed a 10-point Likert scale survey exploring perceived confidence, knowledge, and hospital readiness. Additionally, students completed three 15-minute written clinical vignettes to evaluate interprofessional competencies one month prior to the simulation, the day before the simulation training, and immediately following the second day of training. Appropriate statistical analysis revealed students' self-ratings of confidence, preparedness, and knowledge had significantly increased. Overall scores on clinical vignettes across the three time points also significantly

to become proficient and effective facilitators (Dudding and Nottingham, 2018; MacBean et al., 2013).

Although the challenges to integration require consideration by stakeholders, the literature in this area is progressing through ongoing quality improvement. The most recent literature evaluated in this critical review accounts for many of the limitations previously mentioned. For instance, the studies by Hill et al. (2020) and Stead et al. (2020) use rigorous methodology that takes many of the aforementioned limitations into consideration. Moreover, both demonstrate compelling evidence for developing clinical competencies in a simulation, compared to traditional clinical experiences.

Future Research

It is recommended that further research be conducted to strengthen the evidence for use of simulations as means for students to learn and develop clinical competencies for entry to practice. To this end, the following recommendations may be considered:

a) Conduct studies with a control group to compare student outcomes with simulation and traditional placement only.
b) Use standardized tools that are validated and reliable to measure outcomes and support comparisons across time and groups.
c) Evaluate acquisition of clinical competencies using standardized behavioural or technical criteria.
d) Use probability sampling methods to minimize bias and improve generalizability of results.
e) Investigate the processes and parameters that constitute a successful simulation (e.g. timing, sequence, duration, etc.) to develop a framework for implementing simulations.
f) Explore the effectiveness of the types of simulations in various clinical areas and populations to establish the most effective simulation for a particular disorder area or population.

Clinical Implications

Clinical education is essential to the training of SLPs, but there are growing challenges to acquire sufficient traditional placements. The literature examined in this critical review does not provide sufficient evidence that simulations objectively improve SLP student clinical competency in order to recommend integration of simulation-based learning yet. However, the evidence indicates that simulations are a promising clinical teaching model to support the development of clinical competencies and may be used to supplement time in traditional placements. Additionally, the results help inform the direction for future research in order to elucidate the true benefits and best practices for simulation-based learning.

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