Investigating validity and reliability of virtual patient simulations for self- directed learning and assessment in the medical consultation

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INTRODUCTION

Communication is recognised as a core skill for doctors and is key to transforming clinical knowledge into practice, as such it is an essential component of clinical competence.[1,2] Yet, despite the knowledge that doctor-patient communication is pivotal in determining positive outcomes from consultations, the commonest mistakes reported to the Irish Medical Council (Irish Medical Council Conference, 2012) and the American Medical Association are still ones of communication (rather than failures of knowledge).

Consultation training serves to model the important paradigm shifts that need to be enacted by doctors, as they develop approaches to patient centred consultation.[1] Intensive experience is generally assumed to produce more favourable learning outcomes, but recent research suggests that assessment can be a more powerful driver of student learning depending on instructional format.[3,4,5] Knowledge-based instruction alone may not be sufficient for imparting communication skills in medical education, but aligned with pedagogically sound teaching delivery, practice with stimulated patients and contextualised assessment may have a higher impact on student performance.[6]

Adaptive simulations and personalised learning are becoming an innovative feature of international medical schools for teaching and assessment.[7,8,9] In an adaptive simulation, the simulation environment is not fixed but rather can be modified (or adapted) by the lecturer for optimal pedagogical effect.[10] Simulations can also adapt to the student as they engage in real time with the tasks and scenario presented to them.

The adaptive simulation platform (called SkillSims™) allowed the student to self-assess, practice and master their skills through immersive video based simulations. The scenarios used were psychiatric consultations with two patients respectively portraying mania and depression. The student assumed the role of the doctor, where they could choose (decision points) what the doctor should say and how they should say it, and exhibited various communication skills (optimal and not), accumulating scores as they progressed.

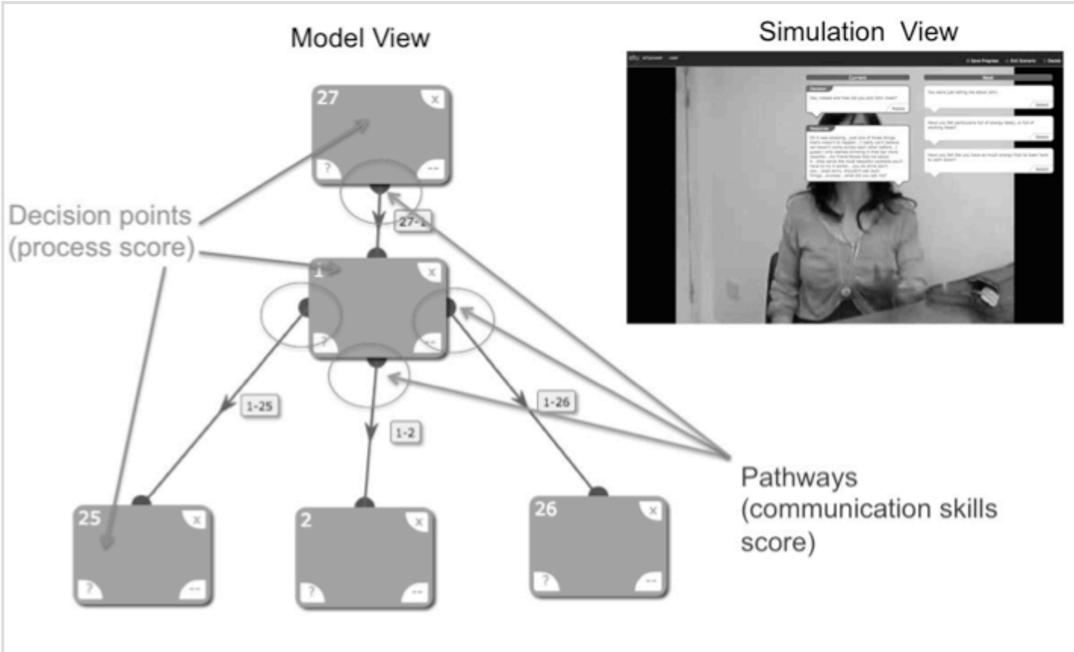

Figure 1. Decision Study

The expert rater of the psychiatry simulations used a scoring system which encompassed knowledge of the consultation process and communication skills for student performance, as it pertains to Calgary Cambridge model of the consultation interview.[16]

Students are presented with a dialogue options, pre-scripted by the expert-rater using an authoring tool within SkillSims™ to form multiple branching dialogue trees (figure 1). Each branch consists of a decision point and a pathway. Both were assigned a score, based on how well that branch demonstrated the communication skills competencies required (within the Calgary Cambridge Model), when compared to the other branching pathway options available.[11-13,15]

This score for decision points and communication skills were examined as part of this Generalizability study. Typically a low score was produced if a student prematurely proceeded from one section to another, or skipped a section entirely (according to expert judgement). The decision making scores are cumulative with the final score being presented to the student once they had finished the simulation.

AIMS

The objective of the research was to explore whether adaptive simulations can produce a valid and reliable measure of undergraduate medical students' consultation skills. The G study tested two variables regarding their potential to support automated self-assessment and practice of undergraduate medical students' consultation skills.

METHODS

A Generalizability analysis was conducted on the IT data analytics collected from the first use of the adaptive simulation, obtained when undergraduate medical students (psychiatry module) at Trinity College Dublin, interacted with two adaptive simulations (as a mandatory part of communication skills training (using the Calgary Cambridge model).[13]

For the purposes of this study, we looked at the scoring mechanisms of these two adaptive simulations to investigate validity and reliability of scoring. The data analytics were provided by the research team who conducted an initial study in 2012 as part of a EU ImREAL project to carry out research and development in the field of experiential virtual training.[11,15,16] Their research on motivation and self regulated learning (SRL) indicated a positive effect on learning motivation and perceived performance with consistently good usability.[11,13,16]

A simple person-by-case (P x C) Generalizability study using existing data of these two cases was used to examine variance components. The variance component estimates from the generalizability study are displayed in Table 1. The generalizability study was conducted on a dataset (n=129) for the variable for a score (y-axis on figure 2) indicating knowledge of process and skills.

Effect	*Degrees of freedom*	*Variance Comp.*	*%*
P	129	0.0924270	11
C	1	0.1053667	13
PC	129	0.6138640	76

Table 1. Generalizability (G) study on 'Score' using a person-crossed-with-cases randomised model.

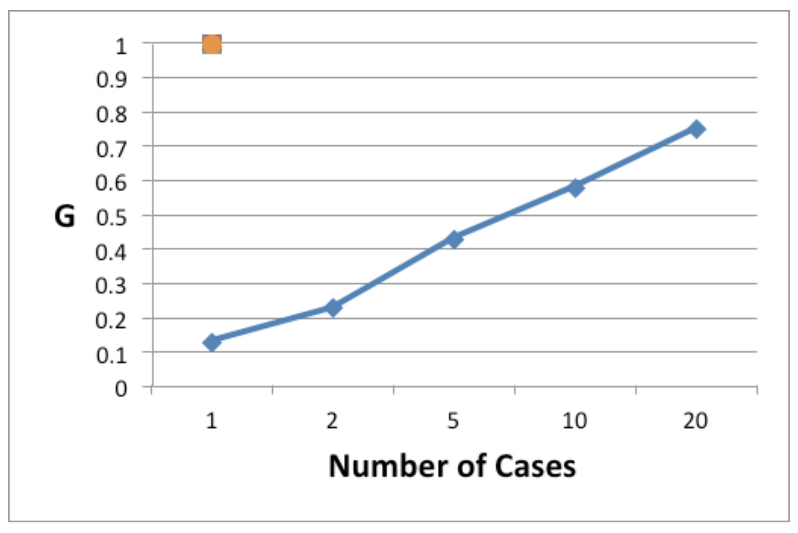

Figure 2 Decision Study

RESULTS

The results produced by the G study on the decision points variable, indicating clinical decision making and confirming user knowledge of the process of the Calgary Cambridge guide to consultation were positive, with the significance level attained being similar to those obtained with expert raters.

The G coefficient for two cases was 0.23, which is consistent with other performance assessment results. In summary, the automated scores using the decision points variable are similar to those obtained with rater -based scores. The results produced by the G study on the decision points variable, demonstrated that it could be used as an indicator of knowledge of the process of Calgary Cambridge consultation skills.

DISCUSSION

The automated assessment of decision points in the simulation are of similar robustness to those obtained with expert raters and so this approach and scoring has potential for wider use in automated assessment of medical students.

The findings indicate that this approach to adaptive simulations has potential as a teaching and assessment tool for the medical consultation, which requires further development and research.

Assessment in medical education addresses complex competencies, requiring quantitative and qualitative information from different sources as well as professional judgement from an expert rater. Performance with simulated patients is a key learning modality for undergraduate medical consultation skills.

The use of simulation and technology for learning, teaching and assessment has increased and virtual patient simulations are becoming an innovative feature of technology enhanced learning (TEL) i to support learning and assessment. This study explores whether this approach is a feasible and robust technology solution for supporting automating learning and assessment.

CONCLUSION

In this adaptive simulation of the medical consultation to assess student performance the automated scoring of decision points in the adaptive simulation produced results similar in robustness to those obtained with expert raters. This approach and scoring have potential for wider use in automated assessment of medical students.

The findings indicate that this approach to adaptive simulations has potential as a teaching and assessment tool for the medical consultation, which requires further development and research.

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REFERENCES

1. Stewart M. Patient-Centered Medicine: Transforming the Clinical Method. Vol Patient-centered care series. Abingdon: Radcliffe Medical Press; 2003.
2. Tamblyn R, Abrahamowicz M, Dauphinee D, et al. Physician Scores on a National Clinical Skills Examination as Predictors of Complaints to Medical Regulatory Authorities. JAMA. 2007;298(9): 993.
3. Van der Vleuten CPM, Schuwirth LWT. Assessing professional competence: from methods to programmes. Med Educ. 2005;39(3):309–317.
4. Wood T. Assessment not only drives learning, it may also help learning. Med Educ. 2009;43(1):5–6.
5. Raupach T, Hanneforth N, Anders S, Pukrop T, Th J ten Cate O, Harendza S. Impact of teaching and assessment format on electrocardiogram interpretation skills. Med. Educ. 2010;44(7):731–740.
6. Van den Eertwegh V, van der Vleuten C, Stalmeijer R, van Dalen J, Scherpbier A, van Dulmen S. Exploring Residents' Communication Learning Process in the Workplace: A Five-Phase Model. Launois P, ed. PLoS One. 2015;10(5):e0125958.
7. Scalese RJ, Obeso VT, Issenberg SB. Simulation Technology for Skills Training and Competency Assessment in Medical Education. J Gen Intern Med. 2007;23(S1):46–49.
8. Okuda Y, Bryson EO, DeMaria S, et al. The Utility of Simulation in Medical Education: What Is the Evidence? Mount Sinai Journal of Medicine: A Journal of Translational and Personalized Medicine. 2009;76(4):330–343.
9. Gaffney C, Dagger D, Wade V. Authoring and Delivering Personalised Simulations-an Innovative Approach to Adaptive eLearning for Soft Skills. J. UCS. 2010;16(19):2780-2800.
10. McGee E, Dagger D, Gaffney C, Power G. Empower the User SkillSims Support Documentation, Empower the User Limited, Dublin, Ireland, 2013.
11. Wesiak G, Steiner CM, Moore A, et al. Iterative augmentation of a medical training simulator: Effects of affective metacognitive scaffolding. Comput Educ. 2014;76:13–29.
12. Gaffney C, Dagger D, Wade V. Supporting personalised simulations: a pedagogic support framework for modelling and composing adaptive dialectic simulations. Proceedings of Summer Computer Simulation Conference; 2007 Jul 15-18:1175-1182.
13. Kelly, F. Dagger, D, Gaffney, G., et al. Student Attitudes to a Novel Personalised Learning System Teaching in Medical Interview Communication Skills. In Marcus-Quinn A. Bruen C. Allen M, Dundon A, Diggins, Y, editors. The Digital Learning Revolution in Ireland: Case studies in practice from NDLR. Cambridge Scholarly Press, Cambridge, UK;2012:99-104.
14. Berthold M, Moore A, Steiner CM, et al. An initial evaluation of metacognitive scaffolding for experiential training simulators. Proceedings of European Conference on Technology Enhanced Learning; 2012 Sep 18-21; Saarbrucken, Germany. Berlin Heidelberg; Springer; 2012.
15. Wesiak G, Moore A, Steiner CM, et al. Affective Metacognitive Scaffolding and Enriched User Modelling for Experiential Training Simulators: A Follow-Up Study. Scaling up Learning for Sustained Impact. 2013:396–409.