First-year physiotherapy students who elect to participate in simulation-based learning activities benefit from the experience

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Abstract

Introduction: Simulation-based learning (SBL) activities are beginning to be effectively incorporated into physiotherapy entry-level curricula, and there is evidence suggesting they should be introduced early in order to facilitate later complex learning. The aims of the study were to implement SBL into the first-year physiotherapy programme and to evaluate subsequent practical performance of both technical and non-technical skills and the extent to which students valued and enjoyed the experience.

Methods: During first semester of 2015, 149 first-year physiotherapy students, enrolled at Curtin University, participated in SBL scenarios involving implementation and practice of clinical skills taught in their practical class. Students then completed a questionnaire rating their enjoyment of the activity. Final marks for the middle and end of semester practical assessments were collated, and these marks were cross referenced to the SBL activity attendance records.

Results: Those students who attended both SBL activities failed on fewer occasions ($p = 0.001$) and scored significantly higher than those who had attended one or none ($p < 0.001$). The majority of students felt that the SBL activities were a positive learning experience (85%) that created a realistic environment (74%) with realistic simulated participants (78%). Students most valued having a "real" age-appropriate patient in a realistic clinical setting with whom they undertook a relevant task.

Conclusions: First-year physiotherapy undergraduate students enjoyed SBL activities and benefitted from them in terms of their practical assessment mark and grade.

Keywords: simulation; simulation-based learning; physiotherapy.

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Introduction

First developed systematically for use in aviation training, simulation is a modality that has widespread application across many fields of learning, including healthcare. As a modality, it has much to offer, in that it allows repeated and deliberate practice in a safe environment (Bond & Spillane, 2002; McLaughlin, Doezema, & Sklar, 2002; Morgan, Cleave-Hogg, McIlroy, & Devitt, 2002). Scenarios may be used to meet a wide range of learning outcomes, including the development of assessment skills, clinical reasoning and non-technical skills such as communication, professionalism, teamwork and reflective practice (Weller, Nestel, Marshall, Brooks, & Conn, 2012). It provides a powerful vehicle for practice in giving and receiving feedback that may improve performance (Fanning & Gaba, 2007; McGaghie, Issenberg, Petrusa, & Scalese, 2010).

Doctors have found simulation-based learning (SBL) to be educationally effective (Issenberg, McGaghie, Petrusa, Lee Gordon, & Scalese, 2005) and have used the modality to train such specific physical skills as central venous catheter insertion, demonstrating positive clinical outcomes (Barsuk, Cohen, Feinglass, McGaghie, & Wayne, 2009) and improvement in skill level (Evans et al., 2010). It has also been used in training for more generic episodes of care, such as trauma (Lee et al., 2003), for critical assessment skills (Steadman et al., 2006) and in anaesthesia (Morgan et al., 2002).

Nursing training programmes also use SBL to teach patient safety competencies (Ironside, Jeffries, & Martin, 2009), manual skills such as catheterisation (Johannesson, Silén, Kvist, & Hult, 2013) and to guide clinical judgement (Traynor, Gallagher, Martin, & Smyth, 2010), coach organisation skills (Traynor et al., 2010) and promote teamwork (Ballangrud, Hall Lord, Hedelin, & Persenius, 2013). Numerous nursing studies have reported that facilities using human patient simulation value the modality (Davis, Kimble, & Gunby, 2014; Shinnick, Woo, & Mentes, 2011), and there is considerable literature outlining the components of effective simulation training in nursing (Garrett, MacPhee, & Jackson, 2010; Kelly, Hager, & Gallagher, 2014).

In other allied fields of health, applications have been slower to develop at both tertiary training facilities and departments within major teaching hospitals. Simulation literature is emerging in the pharmacy domain, particularly in the areas of professionalism and communication (Fejzic & Barker, 2015; Rickles, Tieu, Myers, Galal, & Chung, 2009). In physiotherapy, a recent review reported that SBL activities are beginning to be effectively incorporated into physiotherapy entry-level curricula (Mori, Carnahan, & Herold, 2015), however the literature is limited. Studies have reported using simulation in physiotherapy for skill-based training (Chang, Chang, Chien, Chung, & Hsu, 2007), for assessment of patient domiciliary function (Sabus, Sabata, & Antonacci, 2011) and in various elements of critical-care training (Ohtake, Lazarus, Schillo, & Rosen, 2013; Smith, Prybylo, & Conner-Kerr, 2012). There is evidence suggesting that SBL should be introduced early into curricula in order to facilitate more complex learning later (Henneman et al., 2010).

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Aims

The primary aim of this study was to implement two novel simulation experiences into the undergraduate curriculum in the first year of a physiotherapy programme and to evaluate subsequent practical performance of both technical and non-technical skills and the extent to which students valued and enjoyed the experience.

Methods

Study design

This was a prospective observational cohort study of first-year physiotherapy students who undertook one or two SBL activities. Post-participation in the activity, observations of both academic achievement in terms of practical assessment and student feedback were made. Specific study questions were:

1. Would students choosing to participate in SBL activities perform any better in final practical assessment than those who chose not to participate?
2. Would students enjoy and value the SBL experience?

Participants

During 2015, as part of a compulsory undergraduate unit "HEAL 1000: Introduction to Physiotherapy Practice", all first-year physiotherapy students at Curtin University were invited to attend two non-compulsory simulation activities within scheduled practice time during first semester. Both activities preceded practical examinations for the unit.

This study had approval from the Curtin University Ethics Committee (Approval number PT010/2014). Students were under no obligation to attend the SBL activities or complete the survey, and it was explained that their attendance would have no bearing on their mark for the unit.

Scenario development

Two scenarios were developed by the unit coordinator and the simulation team that encompassed the implementation and practice of technical skills taught in classes as well as the non-technical skills of communication and professionalism. One scenario involved an elderly patient with right leg weakness, and the task was to complete a safe wheelchair-to-bed transfer; the other scenario involved a patient who had a right knee fracture that had been internally fixated, and the task was to perform knee passive movements and then complete a safe transfer from the bed to a wheelchair. Students were expected to greet the patient appropriately, explain the task and gain patient consent before proceeding. They were also expected to adhere to infection control and patient safety guidelines. Both "patients" were simulated participants who had been provided a script and trained in their role prior to the activity.

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Process

Students attending the scenarios were marked as attending on a class roll. Every student who attended participated in the delivery of the scenario, but not all students were allocated the role of the physiotherapist. Students experienced the scenario once, and their performance was captured on video. On completion of the simulation, all students underwent a debrief with both their peers and tutors. This debrief involved discussion of key points and the replay of their performance on video. Following this, students viewed another video where their tutor undertook the same task with the same simulated patient, enabling them to compare their own performance. All students were then invited to complete a questionnaire relating to the value they placed on the experience.

Outcome measures

The questionnaire had eight statements relating to the SBL activity (abbreviated in Figure 3). Students were asked to indicate their level of agreement with the statements by ticking a box under the following headings: not true, slightly true, moderately true, mostly true or very true. There was then room for qualitative comments relating to the activity.

All first-year students undertook middle- and end-of-semester practical examinations, and assessors were blind as to whether they had attended any SBL activities or not. Final marks for these assessments were then collated for all students, and these marks were cross-referenced to the SBL activity attendance records. Both numeric mark and categorical mark were collated whereby "fail" scored less than 5 and "pass" scored 5 or above, as per unit guidelines. Both numeric and categorical marks were collated and analysed because, whilst categorical results matter more for institutional purposes, anecdotally students are always interested in their numeric mark as much as whether or not they passed or failed an assessment. Comparison was made between students who had completed all, one or none of the simulation scenarios as to the final grade achieved in the middle- and the end-of-semester practical assessments.

Statistics

Summary statistics, including means, standard deviations and ranges are provided. One-way ANOVA was used to investigate whether there were differences between groups in exam performance (with significance set at $\alpha = 0.05$). Post-hoc tests with pairwise comparisons were then used to locate the source of significance. All analyses were conducted using IBM SPSS Statistics for Windows, Version 22.0 (Armonk, NY: IBM Corp. Released 2013).

Qualitative data were reviewed and common themes were derived by one author (DD). Discussion relating to reaching consensus on these themes was undertaken by all authors, and then a second coding phase was carried out (by DD and AF) in order to group statements according to those themes.

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Results

Student participation

Overall, 149 students participated in at least one SBL activity, and 35 students did not attend any. There were 6 students who withdrew from the unit after the middle of semester, and these students did not undertake either SBL activity. In addition, those students attending SBL Activity 1 may not have been the same students who attended SBL Activity 2, as reflected in participation flow in Table 1.

Student mark achieved

Following the mid-semester practical examination, there was no significant difference (p = 0.152) in the numeric mark received by those who had undertaken SBL Activity 1 and those who had not (Table 2). Following end-of-semester practical examination, there was a significant difference in the numeric mark received by those who had

Table 1
Participant Flow

		End-of-semester simulation-based learning activity (SBL 2)		
		Attended	Did not attend	Total
Middle-of-semester simulation-based learning activity (SBL 1)	Attended	103	27	130
	Did not attend	19	35 (29)*	54 (48)*
	Total	122	62 (56)*	184 (178)*

*minus 6 students at end of semester who withdrew from unit after mid-semester assessment

Table 2
Differences in Examination Results Using Numeric Mark out of 10

		Mean (SD)	Confidence interval	*P*-value
Mid-semester mark	(n = 184)			
Did not attend SBL 1	(n = 54)	5.7 (2.0)	5.2–6.3	
Attended SBL 1	(n = 130)	6.2 (2.0)	5.8–6.5	0.152
End-semester mark	(n = 178)			
Did not attend SBL 1	(n = 48)	5.6 (2.0)	5.1–6.2	
Attended SBL 1	(n = 130)	6.6 (1.8)	6.3–7.0	0.002
End-semester mark	(n = 178)			
Did not attend SBL 2	(n = 56)	5.6 (1.9)	5.1–6.1	
Attended SBL 2	(n = 122)	6.7 (1.8)	6.4–7.1	< 0.001
End-semester mark	(n = 178)			
Attended no SBL activity	(n=29)	5.4 (1.8)	4.7–6.0	
Attended one SBL activity	(n=46)	5.9 (2.1)	5.3–6.5	
Attended both SBL activities	(n=103)	6.9 (1.7)	6.5–7.1	< 0.001

p-value derived from one way ANOVA

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undertaken SBL Activity 1 (p = 0.002) or SBL Activity 2 (p < 0.001) and those who had not. There was also a significant difference in the mark received by those who had attended none, one or both SBL activities (p < 0.001).

Post-hoc multiple comparisons using Bonferroni correction to locate the source of significance in the overall data found that there was no significant difference in the end of semester mark between students attending none and attending one SBL activity (p = 0.809), but significant difference between students attending both and attending one SBL activity (p = 0.009) or none (p = 0.001).

Categorical marks are shown in Figures 1 and 2 and demonstrate similar trends to those of the numeric marks. Comparing those students who passed or failed, there was a significant difference found between all four groups (Figure 1, p = 0.008). When combining groups, there were only significant differences between students attending both SBL activities compared to those attending one or none (p = 0.001), indicating that a significantly higher percentage of students who attended both SBL activities attained a pass mark.

Student perception of value

There was a 100% survey response rate from SBL participants, and their feedback as to how well the learning activity supported their needs is shown in Figure 3. The majority of students felt that it was "very true" that the simulation was a positive learning experience (85%) that created a realistic environment (74%) with realistic volunteers (78%). Students almost unanimously agreed that it was "very true" that the content

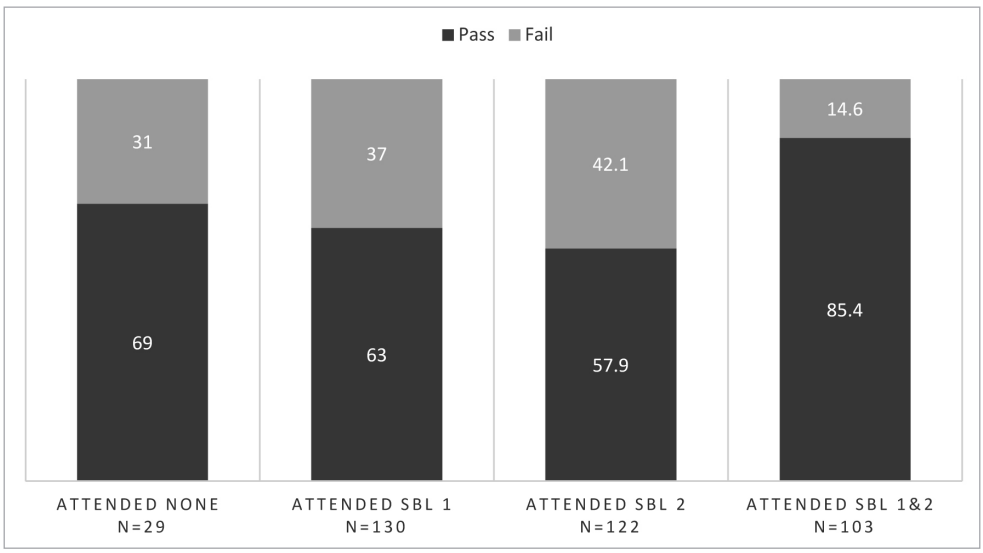

Figure 1. End-of-semester pass/fail results as percentage across attendance at SBL activities*.
*significant difference p = 0.008

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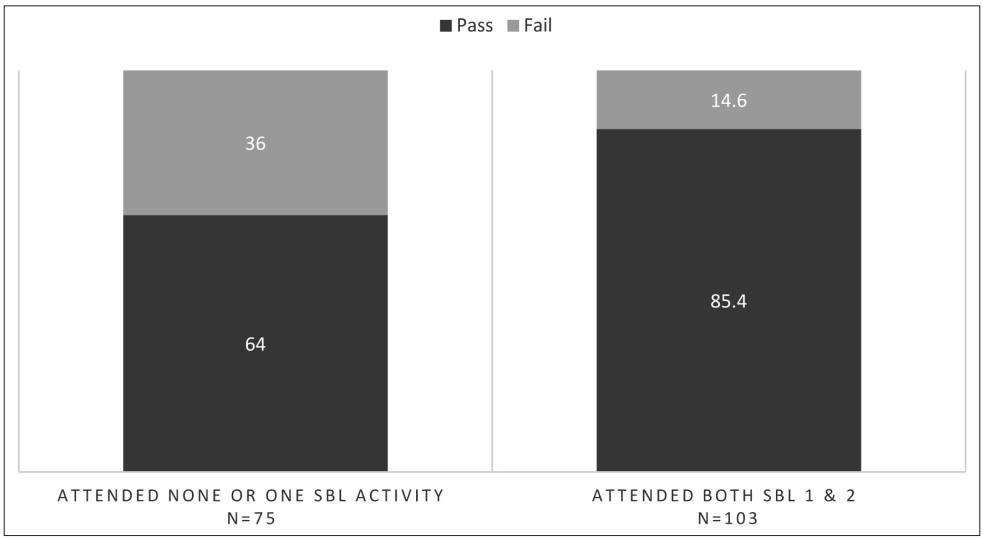

Figure 2. End-of-semester pass/fail results as percentage across grouped attendance at SBL activities*.
*significant difference $p = 0.001$

of the activity was useful (93%). Most agreed that it was "very true" that they enjoyed participating (68%) and learned something surprising or unexpected (64%). Almost all of the cohort agreed that it was "mostly true" or "very true" that the information provided enabled them to develop confidence (96%), and that completion of the activity provided them a sense of accomplishment (89%).

Student qualitative data

Qualitative data from survey responses pertaining to what the students thought was most beneficial are summarised in Table 3. The most common recurring theme was that students valued having a "real" age-appropriate simulated patient in a realistic clinical setting with whom they undertook a relevant task. They also found the simulation valuable as a learning activity. They reported learning by making or observing mistakes and through self-reflection. They also reported learning the value of considering the aspects of planning in assessment and treatment. There were a large number of responses that described the debrief portion of the learning activity as being the most beneficial. Students reported that feedback from peers, multiple supervisors and the actors themselves were all important and useful. There were also a large number of respondents who indicated that the use of video playback—either of themselves or of their tutor's performance of the task—was valuable. The final theme, as to the benefit of the simulation, was that it enabled practice, both for upcoming exams and also for general handling, time management and in dealing with the personal stress of being in a novel clinical situation.

Overall, comments mostly conveyed that the SBL activities provided a great experience that was both enjoyable and useful. Many students requested that there should be more of these experiences introduced to the programme, and that everyone should be afforded the opportunity to be the leading therapist in the learning activity.

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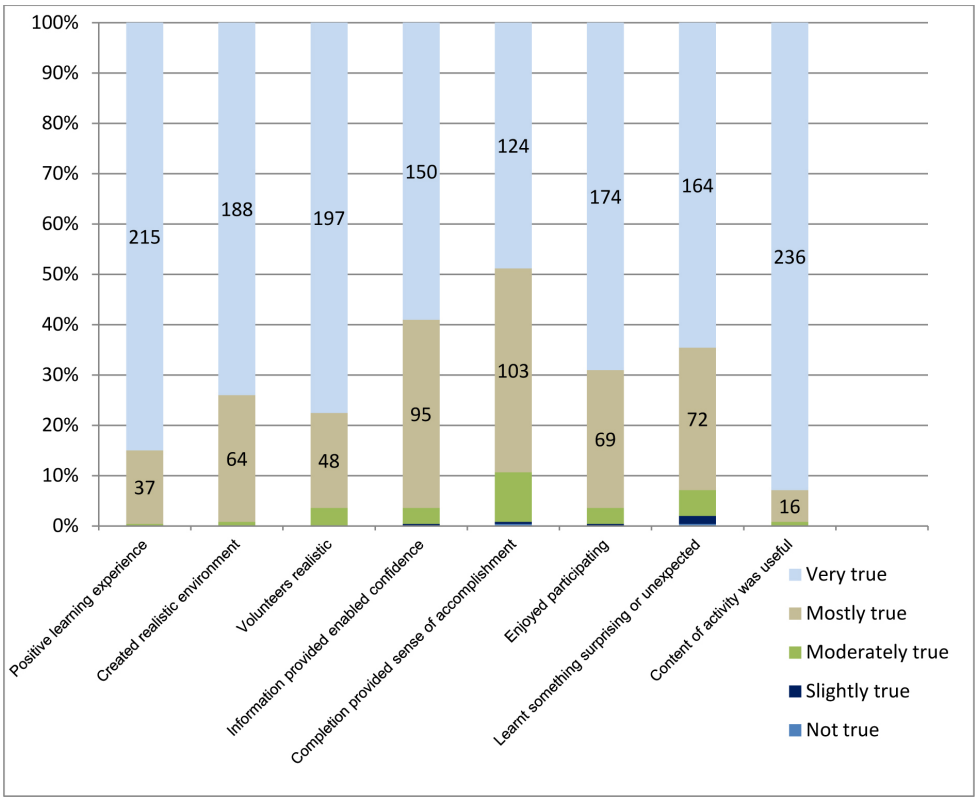

Figure 3. Student rating of how well the SBL supported their learning needs, n = 252.

Table 3
Themes of Benefit

Themes	Comments
1. Realism: A. A "real" patient	• Older actor was very realistic and convincing · "puts things into perspective about how real patients react" · "helpful to practise on a real patient who doesn't know what we are trying to do" · "great acting" · "good preparation for a real patient" • Much better to handle and practise on actor rather than on peers · "real patient instead of peer was invaluable" · "actor versus fellow student much more real" · "really different handling with real patient rather than student" · "will be able to perform better with a real patient now in clinic" • Great interacting with real patient · "good practice communicating" · "good to remember to consider patient comfort more"

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B. A realistic environment	• Having a realistic environment · "having a realistic clinical environment was great" · "it was worthwhile to become familiar with equipment" · "definitely decreases the nerves" · "well set up"
C. A realistic scenario	• Having a realistic scenario was great · "scenario was well thought out and realistic"
2. Learning: A. Things learned	• Learned from my mistakes, or the mistakes of others · "I learned about careless mistakes that are easily forgotten" · "I recognised more of the safety risks" · "I recognised how to correct early mistakes" • Learned through observation · "you learn a lot from watching; you learn a lot from doing" · "I recognised the little things" · "I learned from others" • Planning · "it was great to be able to pull everything together" · "it was great to practise planning"
B. Self-reflection	• Self-reflection very useful • Recognising own weaknesses · "I learned where I needed to improve" · "I know what I need to work on" · "I realise my own personal knowledge shortfalls" • Practice · "it is an alert for me to practise more" · "gave me confidence"
3. Feedback: A. Debrief	• Debrief most beneficial · "lots of feedback" · "feedback from peers useful" · "analysing whole session useful" • Feedback from multiple supervisors was useful · "immediate active feedback from multiple people was good" · "learning from other experienced staff rather than just the lecturer was good" • Actor feedback was worthwhile · "patient feedback was beneficial"
B. Video	• Video playback of student performance was most beneficial · "reviewing my own performance really helped me" • Tutor video play back was beneficial for comparison · "being able to compare my performance to a gold-standard performance was really helpful"
4. Practice: A. For examination	• Good for practice before the exam · "highlighted my strengths and weaknesses" · "practised feeling comfortable and performing in stressful situation" • Great learning experience for exam · "the importance of reading the question" · "I became familiar with the exam marking criteria"
B. In general	• Good to be exposed to that sort of pressure · "learned how to deal with stressful situation better" · "learned better time management" • Really appreciated the opportunity to practise · "hands-on practice in this environment was worthwhile" · "discovered new ways of doing things"

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Discussion

This study has added to the growing literature around SBL in areas of health professional education outside of nursing and medicine. It has demonstrated that early on in the curriculum (during the first year), physiotherapy students both enjoyed and benefitted academically from participating in SBL activities embedded into practical classes.

The fact that the study cohort were students in their first year of training is important.

Visualisation of theoretical information is often challenging without experience. Simulation-based learning may provide a vehicle that enables students to translate their knowledge to real-world experiences. Having had very little clinical exposure to "real" patients, first-year physiotherapy students could perhaps, for the first time, begin to see themselves as real therapists entering a hospital room as a designated health professional in order to undertake a patient-related task. The simulated patient was somewhat older than the peers with whom they normally practise, and had simulated bruising and complained of simulated pain. Sometimes the simulated patient did not follow the student's instructions well and sometimes they did not understand medical terminology, and all of this added to the "realism" that students reported to value highly. It may be that the earlier students can be exposed to these authentic learning activities, the more solid their grounding will be for more complex clinical reasoning as coursework unfolds.

In addition, the process of nurturing caring communicative health professionals who are able to undertake tasks within a clinical team framework is challenging and takes time. Data presented here suggests that SBL may be a potent modality that learners enjoy. Students described finding the simulation to be a positive learning experience, where they learned something surprising or unexpected. This may have been, in part, because the experience was completely novel to them, and perhaps represented a progression from repetitive practice on their peers in a non-clinical environment. It may also be because it enabled them to overcome performance anxiety related to patients and their environments, or it perhaps provided them an opportunity for safe and deliberate practice of technical and non-technical skills. Either way, if introduced early, the training of technical and non-technical concepts can be reinforced with repetition over subsequent years.

Many students expressed the usefulness of the activity and the desire to undertake more simulation, including repeating the same scenario with more opportunity to be in the therapist role. One of the main themes to emerge from the qualitative data was that the students reported learning a lot from the experience, both from their own mistakes (having undertaken the role of the physiotherapist) and the mistakes of others (through observation of their peers). This reflects that the process of feedback and reflection provided in a SBL format is valuable. Students have the opportunity to learn how to both convey and receive constructive criticism involving their peers and tutors. In our particular model, video playback of the tutor's performance provided a solid basis for comparison and formed part of this feedback. It was deemed particularly useful by students in terms of identifying gaps in knowledge and performance, and this became evident in the assessment marks reported for the end of semester.

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This study reviewed and analysed both numeric and categorical practical assessment results in view of the emphasis placed upon each by competitive students or faculty, respectively.

All students' raw numeric marks were progressively higher from middle to the end of semester, but the gap between those students who had undertaken the SBL activity and those who had not widened to become significant by the end of the semester.

In addition, when looking at overall attendance at both SBL activities, there appeared to be a cumulative effect, whereby students who had undertaken both gained significantly higher results than those who had only attended one or none. This trend suggests a dose effect such that the more SBL activities, the better the exam result. Pragmatically, results suggest that tutors can recommend attending SBL activities to students wanting a higher numeric mark as well as those wanting to pass practical assessments.

Strengths and limitations

Although the SBL activities were offered to all first-year students enrolled in the unit, a strength of the study was that enough students chose to undertake only one or none of the SBL activities to enable data to be stratified according to dosage (none, one or two SBL activities). The effect of student's motivation to attend the SBL activities on study outcomes was beyond the scope of the study and may need further exploration.

A limitation of the study was that no data were collected relating to the age and entry level (school leaver versus mature age) of the cohort, and the effect of these differences may in part explain differences seen in academic performance. Another limitation of the study may have related to survey design, whereby there were more positive "true" statements than not, and no "neutral" category provided. However, positive qualitative statements support the conclusion that simulation was enjoyable, realistic and provided a useful learning experience. A final limitation was that the study involved only a single institution, so that generalisation of results to other facilities may be limited. In addition, the modality is a relatively new innovation at this university. Results are nonetheless positive and encouraging for future development of simulation-based education.

Future studies

The first-year student's appreciation of the value of a simulation-based approach to learning demonstrated here provides encouragement to develop and evaluate new and different activities in the future. The progressive introduction of SBL activities to the second- and third-year physiotherapy curricula is now the challenge, as the simulated clinical environment becomes less novel for these cohorts. Innovations in the delivery of these simulation activities will ensure future success of the modality.

Conclusions

The novelty of SBL activities and the impact of bridging theoretical knowledge to practice will always remain with a first-year cohort, as they are clinically inexperienced. This study has shown that first-year physiotherapy undergraduate students enjoyed SBL activities and benefitted from them in terms of their practical assessment marks and grades.

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References

Ballangrud, R., Hall Lord, M., Hedelin, B., & Persenius, M. (2013). Intensive care unit nurses' evaluation of simulation used for team training. *Nursing in Critical Care*, *19*(4), 175–184.

Barsuk, J., Cohen, E., Feinglass, J., McGaghie, W., & Wayne, D. (2009). Use of simulation-based education to reduce catheter-related bloodstream infections. *Archives of Internal Medicine, 169*(15), 1420–1423.

Bond, W. F., & Spillane, L. (2002). The use of simulation for emergency medicine resident assessment. *Academic Emergency Medicine*, *9*(11), 1295–1299.

Chang, J.-Y., Chang, G.-L., Chien, C.-J. C., Chung, K.-C., & Hsu, A.-T. (2007). Effectiveness of two forms of feedback on training of a joint mobilization skill by using a joint translation simulator. *Physical Therapy*, *87*(4), 418–430.

Davis, A., Kimble, L., & Gunby, S. (2014). Nursing faculty use of high-fidelity human patient simulation in undergraduate nursing education: A mixed-methods study. *The Journal of Nursing Education*, *53*(3), 142–150.

Evans, L., Dodge, K., Shah, T., Kaplan, L., Siegel, M., Moore, C., . . . D'Onofrio, G. (2010). Simulation training in central venous catheter insertion: Improved performance in clinical practice. *Academic Medicine*, *85*(9), 1462–1469.

Fanning, R., & Gaba, D. (2007). The role of debriefing in simulation-based learning. *Simulation in Healthcare: Journal of the Society for Simulation in Healthcare*, *2*(2), 115–125.

Fejzic, J., & Barker, M. (2015). Implementing simulated learning modules to improve students' pharmacy practice skills and professionalism. *Pharmacy Practice*, *13*(3), 583–583.

Garrett, B., MacPhee, M., & Jackson, C. (2010). High-fidelity patient simulation: Considerations for effective learning. *Nursing Education Perspectives*, *31*(5), 309–313.

Henneman, E., Roche, J., Fisher, D., Cunningham, H., Reilly, C., Nathanson, B., & Henneman, P. (2010). Error identification and recovery by student nurses using human patient simulation: Opportunity to improve patient safety. *Applied Nursing Research*, *23*(1), 11–21.

Ironside, P. M., Jeffries, P. R., & Martin, A. (2009). Fostering patient safety competencies using multiple-patient simulation experiences. *Nursing Outlook*, *57*(6), 332–337. doi:10.1016/j.outlook.2009.07.010

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

Johannesson, E., Silén, C., Kvist, J., & Hult, H. (2013). Students' experiences of learning manual clinical skills through simulation. *Advances in Health Sciences Education*, *18*(1), 99–114.

Kelly, M., Hager, P., & Gallagher, R. (2014). What matters most? Students' rankings of simulation components that contribute to clinical judgment. *The Journal of Nursing Education*, *53*(2), 97–101.

ISSN 1442-1100

Lee, S., Pardo, M., Gaba, D., Sowb, Y., Dicker, R., Straus, E., . . . Knudson, M. (2003). Trauma assessment training with a patient simulator: A prospective, randomized study. *Journal of Trauma*, *55*(4), 651–657.

McGaghie, W., Issenberg, B., Petrusa, E., & Scalese, R. (2010). A critical review of simulation-based medical education research: 2003–2009. *Medical Education*, *44*, 50–63.

McLaughlin, S. A., Doezema, D., & Sklar, D. P. (2002). Human simulation in emergency medicine training: A model curriculum. *Academic Emergency Medicine*, *9*(11), 1310–1318.

Morgan, P. J., Cleave-Hogg, D., McIlroy, J., & Devitt, J. H. (2002). Simulation technology: A comparison of experiential and visual learning for undergraduate medical students. *Anesthesiology*, *96*(1), 10–16.

Mori, B., Carnahan, H., & Herold, J. (2015). Use of simulation learning experiences in physical therapy entry-to-practice curricula: A systematic review. *Physiotherapy Canada*, *67*(2), 194–202. doi:10.3138/ptc.2014-40E

Ohtake, P., Lazarus, M., Schillo, R., & Rosen, M. (2013). Simulation experience enhances physical therapist student confidence in managing a patient in the critical care environment. *Physical Therapy*, *93*(2), 216–228.

Rickles, N. M., Tieu, P., Myers, L., Galal, S., & Chung, V. (2009). The impact of a standardized patient program on student learning of communication skills. *American Journal of Pharmaceutical Education*, *73*(1), 4.

Sabus, C., Sabata, D., & Antonacci, D. (2011). Use of a virtual environment to facilitate instruction of an interprofessional home assessment. *Journal of Allied Health*, *40*(4), 199–205.

Shinnick, M., Woo, M., & Mentes, J. (2011). Human patient simulation: State of the science in prelicensure nursing education. *The Journal of Nursing Education*, *50*(2), 65–72.

Smith, N., Prybylo, S., & Conner-Kerr, T. (2012). Using simulation and patient role play to teach electrocardiographic rhythms to physical therapy students. *Cardiopulmonary Physical Therapy Journal*, *23*(1), 36–42.

Steadman, R., Coates, W., Huang, Y., Matevosian, R., Larmon, B., McCullough, L., & Ariel, D. (2006). Simulation-based training is superior to problem-based learning for the acquisition of critical assessment and management skills. *Critical Care Medicine*, *34*(1), 151–157.

Traynor, M., Gallagher, A., Martin, L., & Smyth, S. (2010). From novice to expert: Using simulators to enhance practical skill. *British Journal of Nursing*, *19*(22), 1422–1426.

Weller, J. M., Nestel, D., Marshall, S. D., Brooks, P. M., & Conn, J. J. (2012). Simulation in clinical teaching and learning. *The Medical Journal of Australia*, *196*(9), 594. doi:10.5694/mja10.11474

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