WALKER, C.A. and ROBERTS, F.E. 2020. Impact of simulated patients on physiotherapy students' skill performance in cardiorespiratory practice classes: a pilot study. *Physiotherapy Canada* [online], 72(3), pages 314-322. Available from: https://doi.org/10.3138/ptc-2019-0113

Impact of simulated patients on physiotherapy students' skill performance in cardiorespiratory practice classes: a pilot study.

WALKER, C.A. and ROBERTS, F.E.

2020

Impact of simulated patients on physiotherapy student skill performance in cardiorespiratory: A Pilot Study

Authors – Walker CA[1], Roberts FE[1], Hammerton J[2]

Affiliations: [1]School of Health Sciences, Robert Gordon University, Scotland, UK.

[2]Faculty of Health and Wellbeing, Sheffield Hallam University, Sheffield, England, UK

Qualifications – Walker CA MSc Advancing Physiotherapy Practice, BSc (Hons) Physiotherapy
Roberts FE MSc Physiotherapy (Respiratory), BSc Physiotherapy, PGCert LTHE
Hammerton J PhD, Grad. Dip. Phys

Contact details – Craig Walker c.a.walker3@rgu.ac.uk

Abstract

Background – To date there is no evidence that high fidelity simulation (HFS) improves skill development within the university setting in physiotherapy students**.** With pressures to reduce costs and maintain/improve quality of the learning experience and pressures on clinical placement, it is essential to investigate methods that can improve student skill performance before they undertake clinical practice.

Objective - To investigate 1) The impact of using Simulated Patients (SPs) in a practical class on physiotherapy student skill acquisition; 2) student reflections regarding the intervention.

Design - Pilot study using a single centre (University Clinical Skills Centre) randomised controlled trial.

Methods- Twenty eight undergraduate physiotherapy students matched using previous practical examination grades undertook a two hour practical class where core cardiorespiratory skills were practiced. Pre session resources were identical. Control group practiced on peers, intervention group practiced on SPs. Student's skill performance was assessed two weeks after the class using the Mini Clinical Evaluation Exercise (MiniCEX) including qualitative data from student reflections.

Results: Twenty eight students undertook the practical class and subsequent MiniCEX assessment. A statistically significant difference was found for all aspects of the MiniCEX except medical interview (p=0.072) and physical interview (p=0.688). A large effect size was found for all areas except physical interview (0.154) and medical interview (0.378). Student reflections focused on three key themes: behaviour and attitudes, teaching the skill, and feedback.

Limitations: As a pilot study, data was collected from a small sample based in one university. This limits conclusions relating to statistical significance and generalizability. Additionally the MiniCex is not validated to assess psychomotor skill performance questioning the validity of conclusions.

Conclusions: Findings of this study suggest SP interactions may improve student skill performance, however, further research using a larger sample size and using an outcome validated for this population is required.

Key Words – Simulation, Standardised Patients, Physiotherapy, Undergraduate Education, skill development

Word Count - 3166

Introduction

Periods of supervised clinical practice are a core element of pre-registration physiotherapy education programmes.[1] During these clinical periods, students are responsible for assessing and treating real patients with real conditions/problems. Consequently, assessment and treatment techniques will have real and visible effects. To ensure students can undertake this clinical practice safely and effectively, it is important they achieve deep learning within their university learning.[2] It is imperative that students understand what they are doing, the underpinning rationale, and potential consequences. It is also important to have sufficient skill performance to be able to apply techniques safely and effectively.

The basic skills students' use during clinical periods are taught in the university setting in the first instance, through a combination of theoretical and practical learning. Traditionally, practical learning is undertaken with students practicing on each other, defined as peer practice.[1] However, to achieve the deep and meaningful learning required to be able to transfer the learning to real clinical practice, students need to be exposed to situations that will challenge their knowledge and experience, as this will require them to reframe their knowledge, in essence, achieving deep learning.[3]

For effective learning to occur in clinical practice, it has been proposed that students must achieve basic levels of the hierarchy of competence: feeling safe and secure, self-efficacy, and knowledge and experience of what to expect in the clinical environment.[4] Peer practice in university can allow students to feel safe and secure

and to gain a level of self-efficacy, however, the experience of what to expect in a real clinical situation is not addressed. Students are also more comfortable with each other; they know what is expected of them with each technique and consequently react appropriately.[5]

Shulman's Table of Learning suggests that engagement and motivation are required for deep learning; only once this is achieved can students' move forward to the psychomotor domain, the effective performance of skills.[6] This is supported by Sabus & Macauley who discuss the circumplex model of affect; students will learn more effectively when there is an element of nervousness/tension/ excitement, essentially when students are alert and engaged.[7] When working with peers it is challenging to maintain the alertness required for the focussed and repetitive practice necessary to achieve skill competence, there is no pressure to modify and correct techniques if peers do things correctly.[7]

Internationally reported pressures relating to challenges to placement provision and sufficient student supervision during clinical practice periods mean it is critical that student skills are as strong as possible before they are exposed to the real clinical environment.[8, 9] This will give them the confidence to learn effectively and minimise pressures on already stretched clinicians while ensuring patient safety.[10]

Since Korpi et al indicate that student's expertise is built in real work situations,[11] alternative learning methods such as high fidelity simulation (HFS) '*Simulation experiences that are extremely realistic and provide a high level of interactivity and*

realism for the learner; Can apply to any mode or method of simulation; for example: human, manikin, task trainer, or virtual reality' [12p15] may be beneficial.

Simulation Based Learning (SBL) provides a continuum of complexity and realism and can provide a range of clinical situations from the commonplace to the less frequent but more challenging experiences. This enables students to evaluate the effect of, and modify, interventions as a consequence of 'patient' responses, akin to real situations. Simulated learning already has a strong place in medical and nursing education.[13] In addition Blackstock et al[14] and Watson et al[15] both demonstrated that HFS could replace clinical practice without detriment to student performance in cardiorespiratory and musculoskeletal physiotherapy areas.

However, a wider review of physiotherapy literature shows a small and generally poor quality evidence base relating to HFS with a strong focus on investigating its impact in cardiorespiratory teaching. Findings to date highlight positive student perceptions[16, 17, 18, 19] and possible benefits to application of knowledge.[20, 21] Only one pilot study appears to have assessed whether HFS improves skill performance in physiotherapy students.[22] Phillips et al compared a group of 37 students who experienced HFS using simulated patients (SP) to practice their patient assessment skills and ability to mobilise a patient safely to a control group (traditional peer practice) of 36 students.[22] They found poorer skill performance in the HFS group than the control group. However, students had no prior experience of HFS, which may have increased stress levels and inhibited their learning.[7, 23]

To date there is no evidence that HFS improves skill development in physiotherapy students compared to traditional teaching and learning approaches. Only one pilot study suggests it provides no benefit. As with the health services, universities are experiencing pressures to reduce costs, but maintain, if not enhance, the quality of the learning experience.[24] As a result, with simulation being a costly method of teaching, evidence to support this method of learning is required if it is to continue to be utilised.[22]

Aim

The aim of this exploratory study therefore were to 1) investigate the impact of incorporating SPs into a physiotherapy practical class on student performance of core cardiorespiratory skills, and 2) gather initial student views on this learning method through their reflections.

Method

Study Design

An exploratory pilot study using a single blind randomised controlled method with an embedded qualitative component was undertaken.[25] This enabled quantitative measurement of skill performance through use of the mini clinical evaluation exercise (MiniCEX), with qualitative data gathered from student reflections.[26, 27]

A current lack of evidence in this area indicated that an initial exploratory pilot study was appropriate to establish if the intervention appears to have an effect and also to

investigate student views on the learning approach compared to the traditional low fidelity learning experiences. This would then indicate the value of undertaking further study in this area and, if appropriate, provide effect sizes for a larger randomised controlled trial.

At the study institution, grades are calculated (A-F) and consequently a matched pair's design allowed allocation of students with comparable ability across both groups and consequently more accurate comparison of results between the SPs (HFS group) and a control group, who received traditional peer practice [low fidelity simulation (LFS)].[28] The study was approved by the School of Health Sciences Research Review group (ref no:SHS/16/02); gatekeeper approval was gained from the course leader.

Participants and Setting

A convenience sample of students from year two of a four year BSc (Honours) physiotherapy programme at one Scottish University were invited to participate in the study. The primary researcher explained the study to all students in the year during a class at the start of their Acute Care module which commenced in semester two. This was followed-up with an e-mail invitation and participant information sheet. Although students had received an introduction to cardiorespiratory skills in year one where they had briefly practiced the skills on each other, previous experience from teaching the Acute Care module showed that retention of these skills was negligible. This module is the main opportunity students have to develop these core skills before using them in practice. Students were advised they would be randomly allocated to a peer

practice group (LFS) or one that would practice the same skills on SPs (HFS). They were also advised participation was voluntary, non-participation would not disadvantage them in any way, and that they could withdraw from the project at any time with no impact on their module assessment grade. To reinforce this, the module leader was not involved in data collection for the study. Those who wished to participate were asked to reply to the invitation email and to provide written informed consent.

The year two students had undertaken three clinical placements, focused on care of the elderly, outpatient musculoskeletal, community, orthopaedic or neurology areas before this module. They had also experienced working with SPs during HFS to practice assessment skills, including subject history taking and objective testing, in these areas. During these activities the SPs work to a case scenario and provided students with feedback on core professional areas such as communication and handling skills, empathy and caring.

All 31 students in the year two class agreed to participate but only 28 attended the practical class and could be included. Blocked randomisation was undertaken which enabled a matched pair design. Students were matched into pairs, with the blocking variable being practical exam results from the preceding module (Grade A-F). They were then randomly assigned to either the HFS (n=14) or LFS group (n=14), using the sealed envelope method of randomisation by a member of the physiotherapy team independent of the study and module.

<u>Intervention - Practical classes</u>

Acute care is taught with a combination of directed study, followed by tutorials/workshops where students actively apply theory to clinical situations. The aim is to promote deep learning. Students also have access to videos detailing the teaching and application of core respiratory techniques, including Active Cycle of Breathing Technique (ACBT). Practical classes are traditionally undertaken in the simulated ward environment, where students practice skills on each other and receive feedback from staff and peers. The ward environment encompasses two six bedded hospital bays which enabled both groups to be taught simultaneously. Each bed space has a bed, patient locker and chair and can be separated from the next bed space by curtains and replicates the environment students will work in during clinical placements. The learning outcomes for both groups were the same:

- To practice teaching the three components of ACBT (breathing control, thoracic expansion exercises and forced expiratory technique).
- To develop skills in modifying ACBT for patients with breathlessness, sputum retention and loss of volume.

The LFS group practiced the skills on their peers, working in threes; one patient, one therapist and one student providing feedback. They were advised to remember to put themselves in the position of a patient and to respond appropriately to instructions, for example if instructions were not clear they were to do what they thought was being asked rather than what they knew they should do. The HFS group undertook their practical class applying and modifying the same treatment techniques on SPs instead of peers. Other than the models for practicing the technique both groups received the same experience. Eight SPs were used for the intervention group ensuring students

generally worked in pairs, one teaching the ‘patient’, while the other took notes and provided feedback to their peer. These students also received feedback from the class tutor in the same way as the control group, and feedback from the SPs.

The role of SPs was undertaken by members of the volunteer patient bank within the university. They are members of the local community who volunteer to take on the role of SPs to facilitate student learning. They have diverse backgrounds and on joining the patient bank receive training on the requirements of the ‘patients’ and providing constructive feedback. Prior to each class the SPs are briefed by the class tutor about what is required of them. Where patient scenarios are used these are sent to the SPs at least two weeks in advance of the session. Each volunteer receives a £20 gift voucher for each period of up to four hours that they are working with students.

For the purposes of this class the SPs were not performing to a specific patient scenario. They were briefed prior to the class about the purpose of the research and that students would be teaching them various breathing techniques. As the SPs had not been involved in these practical classes the techniques were novel to them and they were advised to be themselves. If students did not explain the techniques clearly they were to do what they thought the instructions meant. If they felt the need to ask a question then to do so in the same way a patient would. Students would have to focus on their explanations and problem solve ways to help the SPs achieve the correct techniques. No attempts were made to standardize how the SPs responded so that students experienced more of the reality that patients vary in how they respond. During the practical class students worked with different SPs to enable them to have to modify their explanations depending on the different SPs responses.

In the two hour class, both groups practiced the three components of ACBT, in addition to modifying ACBT for breathlessness, sputum retention and lung volume loss. The classes involved low psychological fidelity simulation and consequently 'patients' were not attached to equipment or wearing costumes. This is typical for our practical classes. Those in the HFS group received feedback from a peer, from the SP through their responses (and explicit feedback about the clarity of their explanations, handling and approach to the 'patient') and from the class tutor. This was provided on the basic skills before the students and SPs were advised the patient had 1) breathlessness, 2) sputum retention and 3) volume loss. Students then had to explain the 'problem' to the SP and modify the techniques as appropriate.

The classes for the HFS and LFS groups ran concurrently with a different tutor facilitating each practical class to prevent contamination. This ensured students did not get an opportunity to talk to each other about their in class experience until it was completed. The tutor for the LFS group had one year of teaching experience in a university setting and 4 years of clinical experience: the tutor facilitating the HFS group had 14 years of teaching experience in a university setting and 12 years of clinical experience. Prior to the class the tutors were briefed on the session learning outcomes and given a clear teaching plan (supplementary data) which detailed facilitation activities.

Outcomes

No specific validated cardiorespiratory physiotherapy outcome measures were identified.[29] Consequently, the MiniCEX was utilised.[26, 27] It assesses communication, professionalism, counselling, attitudes and behaviours and has been shown to be valid and reliable for the assessment of clinical skills and competence in medical students.[30] The student assesses and treats a patient, whilst the clinician rates the student on a Likert scale and provides formative feedback. The reflective component of the MiniCEX provided the opportunity for students to provide information on their self-rated competence, confidence and views of their learning experience (Table 1).

The practical class for ACBT was undertaken in the second week of the six-week module. Data collection was undertaken during the third week only by the primary researcher who was blind to group allocation. Formative feedback on their performance was given immediately on completion of the MiniCEX. Students' then completed the self-reflection component of the MiniCex before returning it to the primary researcher and leaving the room.

Data Analysis

The MiniCEX rates students on a Likert scale (well below expectation for stage of training to well above expectation for stage of training). The six points of the Likert scale were allocated a numerical value (0 = well below expectation, 1= below expectation, 2= borderline, 3=meets expectations, 4= above expectations, 5= well above expectations). This ordinal data enabled the non-parametric Wilcoxon Matched Pairs Signed rank test to be used to compare the matched pairs' performance (SPSS Version 25, IBM Corp, Armank, New York, USA). Due to the small sample exact test results are reported. Statistical significance was set at $P \leq 0.05$. Effect size for the

Wilcoxon Signed Rank tests were calculated.[31] Associations between the HFS and LFS group were investigated using Chi Squared.

Qualitative data from student reflections was analysed by the two primary researchers using a modified thematic framework analysis based on that proposed by Spencer, Ritchie and O'Connor.[32] The researchers, both cardiorespiratory specialists, each have more than 10 years of clinical experience and more than 7 years' experience of working in a university teaching students. Additionally both have an interest in the use of HFS as a learning method. To prevent bias, reviewers independently identified themes and then met to compare and agree those that were appropriate. Data for each group was kept separate. Due to the small amount of qualitative data the descriptive but not explanatory stage of framework analysis was applied.[32]

Results

Data was collected for 28 students. Demographic data for the LFS and HFS groups is provided in Table 2. Table 3 shows the results achieved by each matched pair. The Wilcoxon Signed Rank Test suggest statistically significantly higher medians for the HFS group in all aspects except medical interviewing skills (p=0.72) and physical interviewing skills (p=0.688) (Table 3). The effect sizes for Wilcoxon signed rank tests are large in all areas except medical interviewing (medium effect size) and physical interviewing (small effect size) as per Cohen's criteria (1988) (Table 3). Results for the Chi-Squared test indicate a significant association between improved performance and HFS in all aspects except medical and physical interview skills (p = 0.31 and p=0.856 respectively).

Table 2: Demographic information

Table 3: Data for simulation and control groups

Student Reflections

Analysis of all 28 student reflections about their initial views of this learning method resulted in three key themes; behaviour and attitudes, teaching ACBT to patients, and feedback from 'patients'. Subthemes are shown in Figure 1, along with how they interact.

Behaviours and attitudes

When working with peers students reported they would:

"become more distracted in class with our peers" I_3/C_9

And would:

"go off in tangents with peers/friends" C_4

They also reported feeling more self-conscious as the therapist and more nervous when working with their peers as patients.

''More self-conscious with my peers'' (B1)

This was in contrast to working with the SPs where students reported they felt the need to behave more professionally and be more focused:

"more professional when looking around the class in the practical session" I_1

Teaching ACBT to Patients

Working with the SPs students' reported they were:

"better prepared with reading as they put you on the spot" I_{11}

They also reported that they had to focus more on their explanations of techniques and the clarity of instructions:

"have to explain instructions and modify it" I_4

This may relate to the perception students had that their peers knew the techniques and therefore did the correct technique without even needing instructions:

"peers know what they are asking therefore pre-emptively do it" I_9

Feedback from 'Patients'

Students reported getting little feedback from their peers. This was in contrast to those working with the SPs who reported that feedback from the SPs was much more constructive:

"receive more accurate feedback on handling for example" I_6

Discussion

The results of this exploratory study suggest practicing core respiratory skills on SPs may have a positive impact on skill performance in physiotherapy students. A statistically significant difference was found for counselling and communication skills, clinical judgement, consideration of the patient and professionalism, organisation and efficiency and clinical competency. Students also reported behaving

385 more professionally, being better prepared and focused prior to the class and that the
386 feedback received from SPs was more constructive.
387
388 Although a meaningful difference in scores for the MiniCEX has not been established
389 in the literature, analysis indicates a large effect in favour of the HFS activity on key
390 areas. This is further supported by Chi-Squared test results which indicate a
391 statistically significant number of higher performing students in the HFS group. This
392 suggests that practicing these core skills on SPs improves students' skill development
393 and subsequent skill performance. However, this was only evidenced in areas directly
394 related to the class content.
395
396 Data provided by student reflections suggests the difference in performance may be
397 due to: Improved knowledge prior to the practical class, increased focus during class,
398 having to modify instructions to ensure the SPs understood what was required and the
399 ability to effectively perform the required tasks in a safe, timely and efficient manner.
400 Increased focus also alludes to increased alertness which Sabus and Macauley argue
401 improves learning.[7] Furthermore, students' reported receiving more detailed and
402 specific feedback from the SPs, which would enable them to modify and enhance
403 their technique, enabling reframing of knowledge and experience, promoting deeper
404 learning.
405
406 What was not measured was whether the quantity of practice that students' undertook
407 differed between the control and intervention groups. In addition to reporting
408 improved quality of practice with the SPs, there may have been more deliberate
409 practice which has been reported to improve skill development.[33] Certainly comments

relating to increased focus and fewer distractions with the SPs may infer improved quality, if not quantity of practice. Transfer of learning to practice and retention of learning were also not measured.

These findings are in direct contrast to the only other study found investigating HFS for skill development in physiotherapy students.[22] They found that students who had practiced on peers had fewer safety fails and fails overall compared to those who practiced on SPs. However, a fundamental difference between the studies may be in the use of HFS. Students at the study facility have opportunities to practice undertaking patient assessments on SPs during year one of the course. Consequently they know what to expect and may have achieved sufficient stimulation and arousal from the activity to keep them in the pleasant activation area identified in the Circumplex Model of Affect.[7] Students in the study of Phillips et al[22] may have been working in an unpleasant activation area due to stress from never having worked with SPs before and this may have inhibited their learning.[7] These conflicting findings suggest that further research into the impact of SPs on skill development is warranted.

The two areas found not to improve from the SP interaction were medical and physical interview skills. However, this result is unsurprising as these skills were not a focus of the class that utilised the SPs, these skills having been taught previously with peer practice. Results do indicate that medical interviewing skills was closer to significance than physical interviewing skills.

The focus for SP interactions was on teaching a patient a skill. Consequently, aspects such as counselling and communication skills, professional skills and clinical competence would be expected to improve. Teaching ACBT requires students to explain and demonstrate the technique and the SPs are trained to give feedback on communication skills and professionalism. Students' reported on the development of communication skills due to the need to modify their explanations and communicate more effectively with the SPs than with peers. They were also challenged by SPs asking questions. The need to respond appropriately to SPs questions may have influenced the students' clinical thinking. The results suggest there may be some carry-over of generic skills such as communication and patient care, but the more specific skills of structuring a patient interview which were taught with peer practice, may have limited the degree of difference between groups in this area.

It is possible the difference between groups was not influenced by the SPs but by the tutors facilitating the sessions. The LFS group was facilitated by a tutor with less clinical and teaching experience than the HFS group. The HFS group may have benefited from the greater level of clinical and teaching experience. Further studies using a cross over design or using facilitators with similar experience levels may therefore be beneficial.

Although the MiniCEX is validated for use with medical students it has not been validated to be used in the assessment of practical skills performance with physiotherapy students. It does not provide detail about specific aspects of each technique and this may limit confidence in the results. Using a Likert scale also introduces subjectivity to the evaluation of student performance, although using only

one assessor helped control this variable. Unfortunately, there are no validated outcome tools to measure skill performance in physiotherapy practice[29] and therefore, the MiniCEX was the most appropriate tool available. Another limitation highlighted is the lack of generalisability due to the small sample from one university setting.

Conclusion

The findings of this study suggest that SP interactions may produce benefit to physiotherapy students' skill performance. Further research with an adequate sample size, using an outcome measure that has been validated to accurately measure specific physiotherapy skill performance is required. If it is established that SP interactions improve skill performance, it would then be beneficial to incorporate SP into undergraduate physiotherapy educational practical classes and programs, and investigate whether these enhanced skills are transferred to the clinical environment.

Ethical Approval

The study was approved by the School of Health Sciences Research Review group (ref no:SHS/16/02); gatekeeper approval was gained from the course leader.

References

[1] World Congress on Physical Therapy. WCPT Guideline for Physical Therapist Professional Entry Level Education. London: World Congress on Physical Therapy; 2011. [Cited 2019 March 2] Available from: http://www.wcpt.org/guidelines/entry-level-education

[2] Howie P, Bagnall R. A critique of the deep and surface approaches to learning model. *Teach High Educ*. 2012;18:4,389-400. doi: 10.1080/13562517.2012.733689

[3] Dolmans DHJM, Loyens SMM, Marcq H, Gijbels D. Deep and Surface Learning in Problem Based Learning: A Review of the Literature. *Adv Health Sci Educ Theory Prac*. 2016;21(5):1087-1112. doi: 10.1007/s10459-015-9645-6

[4] Levett-Jones T, Lathlean J. The Ascent to Competence Conceptual Framework: An Outcome of a Study of Belongingness. *J Clin Nurs*. 2009;18:2870-2879. doi: 10.1111/j.1365-2702.2008.02593.x

[5] Houghton CE, Casey D, Shaw D, Murphy K. Students' Experiences of Implementing Clinical Skills in the Real World of Practice. *J Clin Nurs*. 2012; 22:1961-9. doi: 10.1111/jocn.12014.

[6] Goulet C, Owen-Smith P. Cognitive-Affective Learning in Physical Therapy Education: From Implicit to Explicit. *Journal of Physical Therapy Education*. 2005;19(3):67-72.

[7] Sabus C, Macauley K. Simulation in Physical Therapy Education and Practice: Opportunities and Evidence-Based Instruction to Achieve Meaningful Learning Outcomes. *Journal of Physical Therapy Education*. 2016;30(1):3-13.

[8] NHS Education for Scotland. NES Allied Health Professions Education Strategy. 2011. [Cited 2019 March 2] Available from: http://www.nes.scot.nhs.uk/media/5446/AHP-Strategy-The-Next-Chapter.pdf

[9] Wright T, Moss P, Watson K, Rue S. Simulation in Physiotherapy Clinical Training. National Simulated Learning Project. Final Report. Adelaide, Australia. Health Workforce Australia. 2015. [Cited 2019 March 2] Available from: http://lamp.physio.curtin.edu.au/simproj/HWA%20Embedding%20Simulation%20in%20Clinical%20Physiotherapy%20Final%20Report.pdf

[10] World Health Organisation. Patient Safety Curriculum Guide. Multiprofessional Edition. Geneva: World Health Organisation. 2011. [Cited 2019 March 2] Available from: http://apps.who.int/iris/bitstream/10665/44641/1/9789241501958_eng.pdf

[11] Korpi H, Peltokallio L, Piirainen, A. The Story Models of Physiotherapy Students' Professional Development. Narrative Research. *European Journal of Physiotherapy*. 2014;16:219-20. doi: org/10.3109/21679169.2014.934279

[12] Society for Simulation in Healthcare. Lopreiato JO (Ed.), Downing D, Gammon W, Lioce L, Sittner B, Slot V, et al. (2016). *Healthcare Simulation Dictionary.* [Cited 2018 June 29]. Available from: http://www.ssih.org/dictionary.

[13] McGaghie WC, Issenberg SB, Petrusa ER, Scalese RJ, Jumah JAB, Ruland JP. A Critical Review of Simulation-Based Medical Education Research: 2003-2009. *Med Educ*. 2010;44(1):50–63. doi: 10.1111/j.1365-2923.2009.03547.x.

[14] Blackstock FC, Watson KM, Morris NR, et al. Simulation can Contribute a Part of Cardiorespiratory Physiotherapy Clinical Education. *Simul Healthcare*. 2013;8:32-42. doi: 10.1097/SIH.0b013e318273101a

[15] Watson K, Wright A, Morris N, et al. Can Simulation Replace Part of Clinical Time? Two Parallel Randomised Controlled Trials. *Med Educ*. 2012;46:657-667. doi: j.1365-2923.2012.04295.x

[16] Silberman NJ, Litwin B, Panzarella KJ, Fernandez-Fernandez A. High Fidelity Human Simulation Improves Physical Therapist Student Self-Efficacy for Acute Care Clinical Practice. *J Phys Ther Educ*. 2015;29(4):14-24.

[17] Mandrusiak AM, Isles R, Chang AT, et al. Senior Physiotherapy Students as Standardised Patients for Junior Students Enhances Self-Efficacy and Satisfaction in Both Junior and Senior Students. *BMC Med Educ*. 2014;14:105. https://doi.org/10.1186/1472-6920-14-105

[18] Hayward L, Blackmer B. A Model for Teaching and Assessing Core Values Development in Doctor of Physical Therapy Students. *J Phys Ther Educ.* 2010;24(3):16-26.

[19] Lewis M, Bell J, Asghar A. Use of Simulated Patients in Development of Physiotherapy Student Interpersonal Skills. *International Journal of Therapy and Rehabilitation*. 2008;15(5):221-7. doi: 10.12968/ijtr.2008.15.5.29234

[20] Boissonnault W, Morgan B, Buelow J. A Comparison of Two Strategies for Teaching Medical Screening and Patient Referral in a Physical Therapist Professional Degree Program. *J Phys Ther Educ*. 2006;20(1):28-36.

[21] Huhn, K., McGinnis, P.Q., Wainwright, S. & Deutsch J.E. A Comparison of 2 Case Delivery Methods: Virtual and Live. *J Phys Ther Educ.* 2013;27(3):41-48.

[22] Phillips AC, Macintosh SF, Bell A, Johnston KN. Developing Physiotherapy Student Safety Skills in Readiness for Clinical Placement using Standardised

556 Patients Compared with Peer-Role Play: A Pilot Non-Randomised Controlled
557 Trial. *BMC Med Educ*. 2017; 17:133. doi: 10.1186/s12909-017-0973-5
558 [23] LeBlanc VR, Bould MD, McNaughton N, Brydges R, Piquette D, Sharma B.
559 Simulation in Postgraduate Medical Education. Members of the FMEC PG
560 consortium; 2011. [Cited 2019 March 2] Available from:
561 https://afmc.ca/pdf/fmec/18_LeBlanc_Simulation%20and%20Technology.pdf
562 [24] Grove J, 7 key challenges for UK higher education. 2018 [cited 2018 Sept
563 26] Available from: https://www.timeshighereducation.com/features/7-key-
564 challenges-uk-higher-education
565 [25] Orsmond GI, Cohn ES. The distinctive features of a feasibility study:
566 Objectives and guiding questions. *OTJR:* 2015;35(5):169-77
567 [26] Liao KC, Pu SJ, Liu, MS, Yang, CW Kuo, HP. Development and
568 Implementation of a Mini-Clinical Evaluation Exercise (mini-CEX) Program to
569 Assess the Clinical Competencies of Internal Medicine Residents: From Faculty
570 Development to Curriculum Evaluation. *BMC Med Educ*. 2013;13:31. doi:
571 10.1186/1472-6920-13-31.
572 [27] Paravicini I, Peterson CK. Introduction, Development and Evaluation of the
573 Mini Clinical Evaluation Exercise in Post-graduate Education of Chiropractors, *Jo*
574 *Chiropr Educ*. 2015;29(1):22-28. doi: 10.7899/JCE-14-14.
575 [28] Cresswell R. Research Design: Qualitative, Quantitative and Mixed Methods
576 Approaches. 2nd Ed. London: SAGE publishing; 2003.
577 [29]Sattelmayer M, Hilfiker R, Baer G. A Systematic Review of Assessments for
578 Procedural Skills in Physiotherapy Education. *International Journal of Health*
579 *Professions*. 2017; 4(1): 53-65. Doi: 10.1515/ijhp-2017-0008.

580 [30]Yousuf N. Mini Clinical Evaluation Exercise: Validity and Feasibility
581 Evidence in Literature. *Education in Medicine Journal*. 2012;4(1)
582 doi:10.5959/eimj.v4il.8
583 [31] Pallant J. SPSS Survival Manual, chp 16 non-parametric statistics. 6th Ed.
584 Maidenhead: McGraw-Hill.2010.

585 [32] Spencer l, Ritchie J, O'Connor W. In: Ritchie J, Lewis J. *Qualitative*
586 *Research Practice. A Guide for Social Scientists*. London: Sage Publishing;
587 2003:199-21.
588 [33] Welch TD, Carter M. Deliberate Practice and Skills Acquisition in Nursing
589 Practice. *J Contin Educ Nurs*. 2018;49(6):269-273.
590
591
592
593

Tables

Table 1: Reflective questions asked

LFS Group	HFS Group
What are your perceptions and views of the interactions with your peers in practical and simulation teaching? What are your perceptions and views of the interactions with the volunteers in practical and simulation teaching?	What are your perceptions and views of the interactions with your peers in practical and simulation teaching? What are your perceptions and views of the interactions with the volunteers in practical and simulation teaching?

600 Table 2: Student demographics

	LFS	HFS
	n= 14	n= 14
Male/Female (%)	21/79	36/64
Mean age ($\bar{x}$) Standard Deviation (SD)	19.9 1.5	20.6 1.9

601

602
603

604

605

606

Table 3: Results MiniCEX

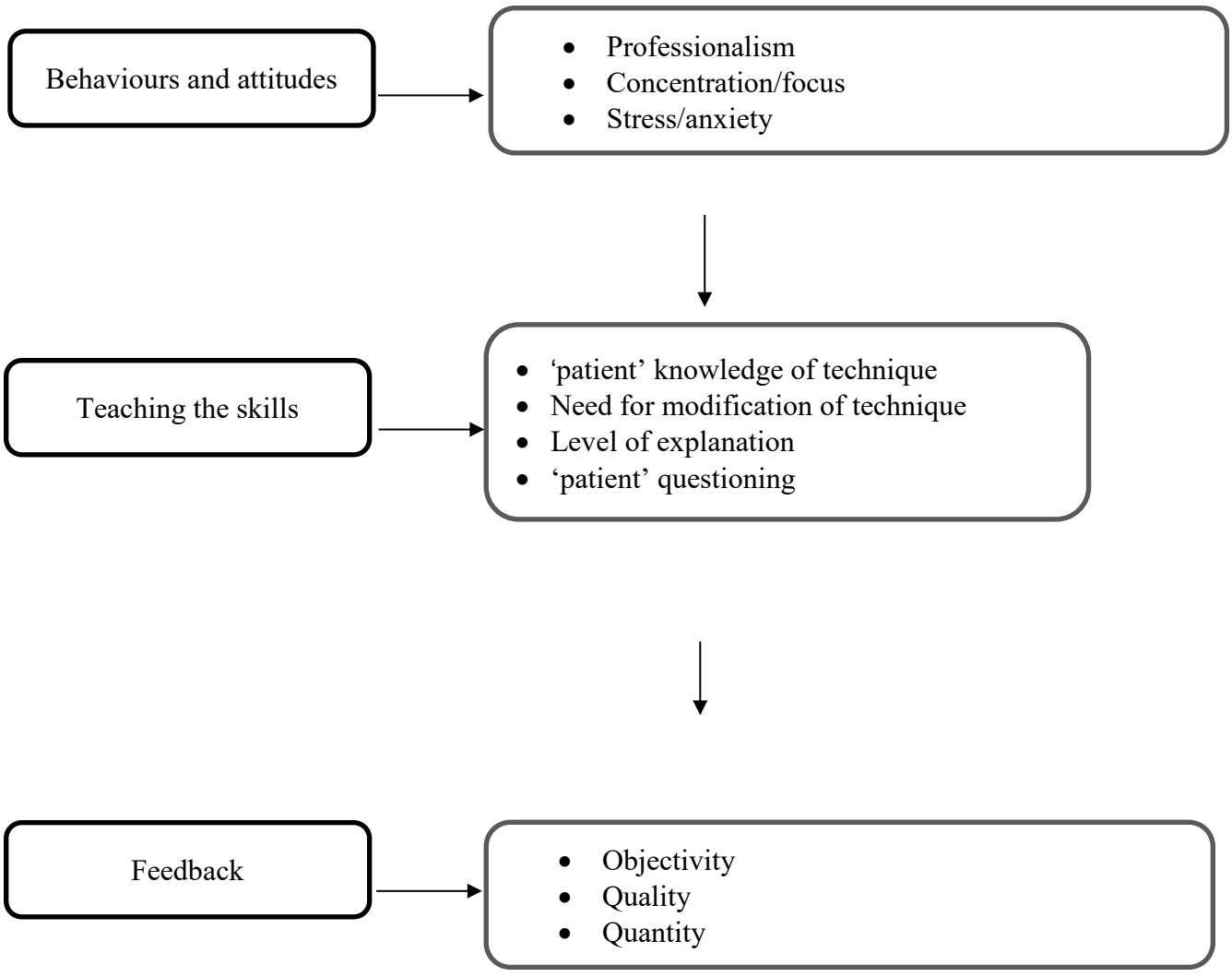
	Medical interview		Physical interview		Counselling and communication skills		Clinical judgement		Consideration of patient and professionalism		Organisation and Efficiency		Clinical Competence	
PAIR	LF	HF	LF	HF	LF	HF	LF	HF	LF	HF	LF	HF	LF	HF
1	2	3*	2	2	3	4*	3	4*	3	4*	3	4*	3	4*
2	2	3*	2	3*	3	4*	2	4*	3	4*	3	5*	3	4*
3	3	3	3	2	4	5*	4	5*	4	5*	4	5*	4	5*
4	3	4*	3	3	3	5*	3	5*	3	5*	3	4*	3	5*
5	2	3	2	2	3	4*	2	4*	3	4*	3	4*	3	4*
6	3	3	2	2	3	5*	3	5*	4	5*	3	5*	3	5*
7	3	2	2	3*	3	4*	4	5*	3	5*	3	4*	3	5*
8	2	2	2	2	3	3	2	4*	3	4*	3	3	3	3
9	2	2	2	2	3	3	2	3*	4	3	3	3	3	3
10	3	2	3	2	3	4*	3	5*	3	5*	4	4	3	5*
11	2	3*	2	3*	5	5	3	5*	5	5	5	5	5	5
12	2	4*	2	2	3	3	3	4*	4	4	3	4*	3	4*
13	2	3*	2	2	3	4*	2	3*	2	3*	3	3	3	3
14	1	3*	1	2	3	4*	3	4*	3	4*	3	4*	3	4*
Mode	**2**	**3**	**2**	**2**	**3**	**4***	**3**	**4/5**	**3**	**4/5**	**3**	**4**	**3**	**5**
Median	**2**	**3**	**2**	**2**	**3**	**4***	**3**	**4**	**3**	**4**	**3**	**4**	**3**	**4**
Wilcoxon signed rank	**p=0.072**		**p=0.688**		**p =0.002**		**p =0.001**		**p =0.005**		**p =0.004**		**p =0.002**	
Z statistic	-1.999[b]		-.816[b]		-2.972[b]		-3.035[b]		-2.804[b]		-2.810[b]		-2.889[b]	
Effect size	0.378		0.154		0.562		0.574		0.530		0.531		0.546	

Cohen's criterion (1988)	Medium	Small	Large	Large	Large	Large	Large
Chi^2	0.31	0.856	<0.001	0.002	<0.001	<0.001	<0.001

LF= low fidelity simulation group, HF = High fidelity simulation group,
0= well below expectation 1= below expectation, 2 = borderline, 3= meets expectation, 4 = above expectation, 5= well above expectation
*=higher score in intervention group
B based on negative ranks

Figures

Fig 1: Themes and subthemes from student reflections



APPENDIX: SESSION PLAN

Aims of the session:

- To practise teaching the three components of ACBT (BC, TEE, and FET)
- To develop skills in modifying ACBT for patients with breathlessness, sputum retention, and loss of volume

Learning outcomes

By the end of the session, the student should be able to

- Effectively teach a patient to perform the components of ACBT.
- Modify their instructions and the performance of ACBT by a patient to ensure appropriate skills are performed.
- Use the components of ACBT in different positions to enhance treatment effect for patients.

Preparation:

Students directed to online video demonstrations of ACBT

Resources: (case studies, feedback sheets)

Programme/Course:	Unit: Acute Care	
Topic: Practical – ACBT for medical respiratory patients	Level of study: 2	Venue:
Title of session: Assessment practical	Session no.:	Date of session:
Name of learning group:	Time of session:	Duration of session: 1 hr, 50 min

Time, min	Learning activities	Teaching activities
10		Learning outcomes for the session: • Clarify feedback sheets, their role • Role of patients – to be a patient, don't know the techniques
5		Review BC elements from video
20	Students to practise teaching BC in groups of • three (patient, student, observer) or • two if SP group (student, observer) Observer and patient to provide feedback Swap patients and bed spaces so working with different people	Staff member to circulate around room providing feedback as appropriate to individual students and observer. If appropriate, can draw group together if same common issue being identified: • Focus on language used by students, hand positions, positioning of self, correction of patient, use of voice.
15	Students to practise teaching TEE, cycling back to BC in same groupings	Staff member to circulate around room providing feedback as appropriate to individual students and observer. If appropriate can draw group together if same common issue being identified. Emphasize the importance of proprioceptive feedback from hands: • Focus on language used by students, hand positions, positioning of self, correction of patient, use of voice.
10	Students to practise teaching FET	Review FET: • May need to focus on keeping glottis open, ways to facilitate this.
10	Break	
10		Modify positioning for breathlessness, unilateral presentations of sputum retention, and loss of volume. Modify technique for different problems: • Incorporate holds and sniffs for loss of volume. • Focus more on TEE and FET for sputum. • Focus on BC for breathlessness.
30	Students to practise in their groups for modifying ACBT for breathlessness, sputum retention, and loss of volume Peers, patient, and tutor to provide feedback	

ACBT

Question	Yes	No	Comments
Did they introduce themselves with full name and "student physiotherapist"?			
Did they check that they had the correct patient?			
Did they ask what the patient would like to be called?			
Did they explain what their role was and what they were going to do?			

BC – did they include the following?	Tick if included	Comments
• Tidal breathing		
• Should be relaxed.		
• Aiming to help get more air to bottom of lungs.		
• Is using diaphragm.		
• Explain what diaphragm is.		
• Position their hand just below xiphisternum.		
• Encourage using a relaxed slow voice.		
• Use analogies or modifications of explanation.		

During BC, circle any of the following that were used:

Push out Instruct when to breath in/out

General comments: Include whether therapist appropriately positioned her- or himself in relation to the patient, etc.

TEE	Tick if included	Comments
• Deep breath used		
• Should think about getting air to the bottom at the sides.		
• Fill the lungs from the bottom upward.		
• Use a motivational voice to encourage deep breath.		
• Appropriately position hands on lateral bases.		

General comments:

FET	Tick if included	Comments
• Explains "It's like a cough but less effort."		
• Explain about open glottis – no vocal sounds.		
• Need to push air out short, sharp, and fast.		
• Stop patient going past closing volume.		

Other general comments to encompass non-verbal communication, use of voice, position and posture of physiotherapist:

ACBT = active cycle of breathing technique; BC = breathing control; TEE = thoracic expansion exercises; FET = forced expiratory technique; SP = standardized patient.