Simulation-based clinical assessment: Redesigning a signature assessment into a teaching strategy

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Research

Simulation-based clinical assessment: Redesigning a signature assessment into a teaching strategy

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Abstract

Introduction
Paramedics entering the professional workforce continually make judgements of their own, and their peers', performances. With little exposure to these processes, exercising these judgements is difficult. Teaching strategies that use self-assessment, peer assessment and reflective practice should improve the acquisition of clinical reasoning and application of clinical skills (1-4). However, clinical programs such as paramedic programs present unique challenges in the development and assessment of clinical skills, because allowing undergraduate paramedic students to work with autonomy beyond their ability presents considerable risk to patient safety.

Methods
This project used a mixed-methods approach to evaluate the new teaching strategy that used simulation-based clinical assessments (SCAs) for learning. Two focus groups, of 1-hour duration with eight participants, were conducted before and after exposure to the teaching intervention. In addition, a self-administered, anonymous voluntary online questionnaire was conducted three times during the semester after each of the three SCA rounds.

Results
Twenty-seven students (69%) answered the pre-survey and 24 (62%) students answered the post-survey; 14 students completed both the pre and post-surveys. The results indicate that changing a SCA from a standalone assessment to a strategy that encourages student engagement has facilitated a deeper understanding and developed desired attributes.

Conclusion
The data from this pilot project has demonstrated that requiring students to have an active role in learning activities by integrating the SCA into the teaching design has improved student confidence and understanding. The SCA used for learning has the potential to be a signature means for clinical educators to encourage and guide learning in paramedic science.

Keywords
simulation; assessment for learning; assessment as learning; peer assessment

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Introduction

Many clinical courses have adopted objective structured clinical examinations (OSCE) or simulation-based clinical assessments (SCAs) (4), suggesting that discipline experts perceive these types of assessment as important. Despite SCAs being embraced by discipline experts, feedback from paramedic students enrolled in courses at the University of the Sunshine Coast (USC) in Queensland, suggests that students may not reap the anticipated benefits of SCAs, as there is a reported increase in the level of anxiety associated with these compared to other types of assessment. This increase in anxiety may contribute to a decrease in student performance.

Based on anecdotal feedback, the authors propose that one possible reason for the increased anxiety reported by students is that the original tutorial simulation-based activities used during the semester usually do not use the same format or criteria as a summative SCA at semester end, and hence do not adequately prepare students for the summative assessment. The issue of non-authenticity of pre-SCA training may reduce confidence and increase anxiety around SCAs, as reported by student feedback.

This research project examined the effectiveness of a new teaching strategy in paramedic science used at USC and examined the perceptions of students during this process. Specifically, the research questions (RQs) are:

1. What effect does the new strategy have on student understanding of their professional role over the semester?
2. Does the new strategy change students' perceptions of the SCAs over the semester?
3. Does the new strategy change students' perceptions of their ability over the semester to make judgements about their and others' work?
4. What are the perceptions of students toward their ability to apply clinical interventions?

Background to the assessment task

The course in which this project was conducted included the following assessment tasks: skills based assessment, a major project (scientific poster), a knowledge exam and an SCA. The intervention discussed in this paper focused on improving the simulation-based assessment task.

Prior to this study, the USC Bachelor of Paramedic Science (BPS) program used SCAs for the sole purpose of summative assessment at the end of paramedic courses. Tutorial activities typically used simulation as the learning strategy with little discussion concerning SCA assessment criteria. At the end of these courses, students attended an SCA session in which a student responded to a patient with a medical emergency. The

SCA in this course was used to assess a student's technical skills, non-technical skills, teamwork, communication and leadership. This type of assessment was chosen based on studies that suggested simulation-based learning is superior to problem-based learning for the acquisition of critical assessment and management skills (5).

The new learning design

The philosophy of the new learning design is to first better align the graduate's attributes, intended learning outcomes, clinical teaching and assessment strategies. The intended learning outcomes of the course were to:

- demonstrate an understanding of a whole person approach to assessment and management
- demonstrate the attainment of clinical competency required to practise, as governed by the state ambulance authority and the Council of Ambulance Authorities (CAA) accreditation body
- demonstrate a safe and practical approach to patient assessment and management through the application of skills, attitudes and attributes combined with knowledge of clinical guidelines that underpin safe practice
- demonstrate a safe and ethical approach to the development, maintenance, referral and termination of the paramedic-patient relationship
- communicate effectively and professionally
- apply an ethical and professional approach to learning and practice
- adhere to paramedic medico-legal responsibilities.

In addition, this teaching intervention aims to increase formative feedback to students throughout the semester, engage them in active learning and improve the authenticity of the teaching and learning design.

To enhance the authenticity of the intervention, students are required to make judgements of their own and other students' work, as would be expected in a professional work capacity. With innovative design the SCA has the potential to develop, and be used to assess, clinical reasoning in a way approximating real practice and build participant confidence through increased efficacy. To facilitate deeper understanding and demonstration of clinical ability, the formative assessment concepts of 'assessment as learning' and 'assessment for learning' were embedded inside the 'assessment of learning' strategy of an SCA. The motivator for this change of focus in assessment was the negative experiences students had with standalone assessments of their learning that they struggled to connect with the learning experiences they were having in class. Assessment for learning focuses on formative aspects of assessment as learning opportunities to improve students' learning outcomes (2).

Formative assessment includes classroom practices such as questioning, understanding learning through observation, sharing learning goals and success criteria and building commitment to those goals among students. Feedback to students that is helpful to them in improving their learning is a significant aspect of formative assessment, and one that is often underplayed (6).

Assessment as learning goes further by focusing on the student's active role in the assessment process that is embedded in the learning with particular reference to self-assessment, reflection and metacognition (2). In assessment as learning, the student's own judgements of their work against pre-determined standards are important so engagement with, and deconstruction of, those standards and how they will be applied become part of the learning experience. The ability to reflect critically as a practitioner, using Schön's framework (7) of reflecting in and on action in this case, is seen as vital to making changes to practice. Metacognition is the third element of this approach to assessment and is designed to strengthen students' awareness of their own thinking and learning strategies. Intervening via formative and summative assessment was seen as an important strategy as engagement with assessment is the point at which student learning becomes evident.

1
- Rubric Analysis (Week 1)
- Deconstruction and reconstruction of the rubric
- Critique of pre-recorded clinical videos

2
- Rubric Analysis (Week 2)
- Reconstruction of the rubric

3
- Formative SCA 1 (Week 3)
- Scenario videoed for reflection
- Self, peer & tutor assessed

4
- Self critique and reflection
- Reflective paper based on their own perceptions of their videoed performance and how they used the feedback provided by peers and tutors to improve clinically.

5
- Formative SCA 2 (Week 8)
- Scenario videoed for reflection - formative process
- self, peer & tutor assessed

6
- Summative SCA (Week 13)
- Original Simulation-Based Clinical Assessment

7
- Post SCA feedback (Week 14 - post teaching)
- Post SCA critical review in which grading notes and video are used for self and guided reflection
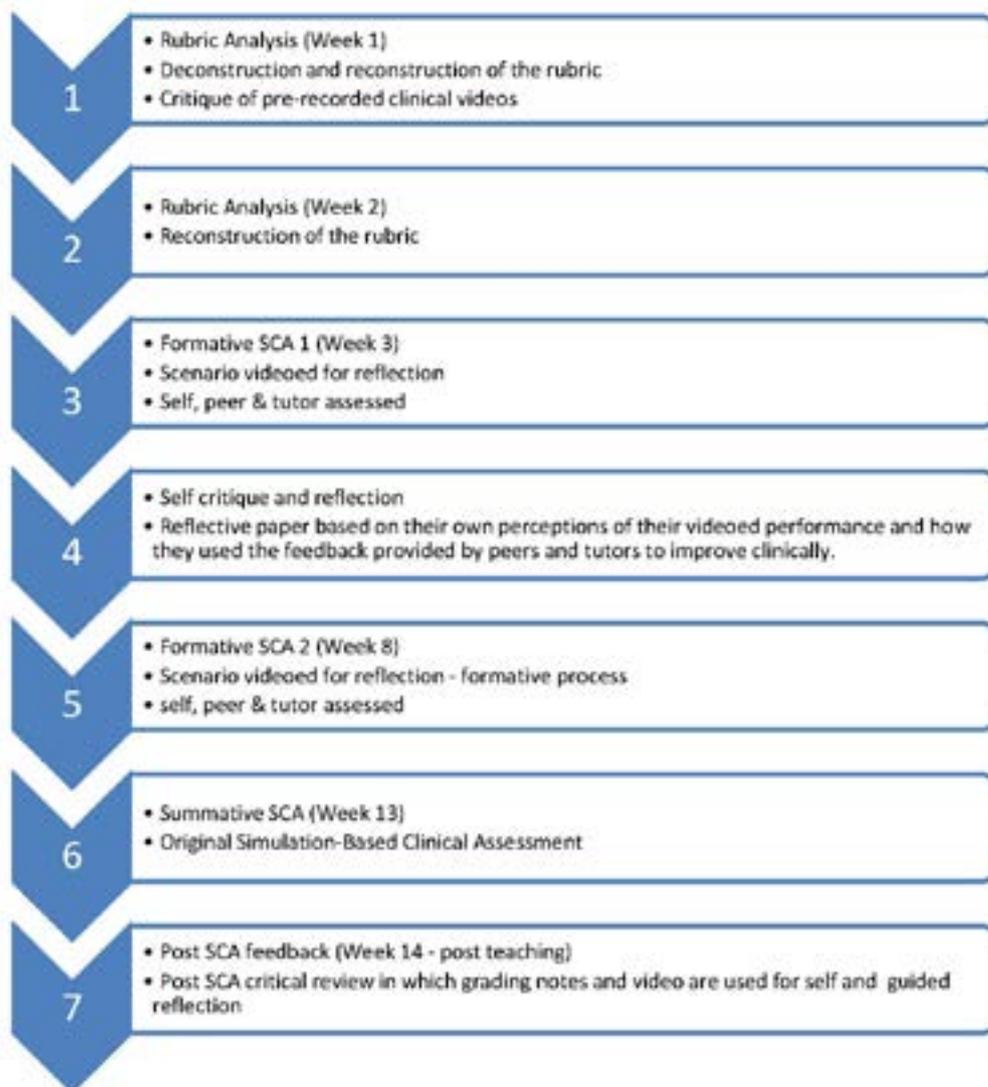
Figure 1. The seven step learning design incorporating for learning and as learning sessions into the assessment strategy

The new learning design has seven components (Figure 1). The process includes students using the SCA for learning (steps 1, 2 and 7), and as learning (steps 3, 4 and 5). This is an advance from the previous use of SCAs solely as assessment of learning (step 6). An expanded explanation of each step is provided below:

1. Rubric deconstruction: In the first teaching session of the course and prior to the first formative SCA, students deconstruct the rubric for final end-of-semester summative assessment. As an in-class group activity, the SCA assessment criteria and standards are analysed by students to improve their understanding of assessment criteria. These standards and criteria are then used by students to judge a previously videoed performance.
2. Rubric redevelopment: The students are guided in class and as a group, to further develop the assessment criteria to improve (if necessary) their understanding while keeping the standards the same.
3. Compulsory formative SCA 1: Formative SCAs are performed and videoed under examination conditions, with the exception that peers and a tutor critique the performance. Immediately after the formative SCA, peer and tutor feedback are provided during a debrief with the participant. Feedback is based on the marking rubric.
4. Self-grading: Participants grade their own performance using the marking rubric. In the first iteration only, students also write a 500 word reflective paper based on their own perceptions of their videoed performance and how they used the feedback provided by peers and tutors to improve clinically. The reflective paper contributed 8% towards the participants overall grades and promotes a deeper understanding of their clinical performance.
5. Formative SCA 2: Steps 1 to 4 are repeated mid semester, including further rubric deconstructions and rubric development. The students are invited to grade their performance but are not required to submit a reflection for summative purposes.
6. Summative SCA: The end-of-semester summative SCA is completed in the final teaching week (teaching week 13). No immediate feedback is given or reflection paper is submitted.
7. Feeding-forward session: The week following the summative assessment, participants are invited to view the video of their end-of-semester SCA for feedback and participate in a tutorial to improve clinical performance.

Methods

This project used a mixed-methods approach to evaluate the new teaching strategy that used SCAs for learning and as learning to encourage participation and facilitate deeper student understanding. The target population for this study was third-year BPS students (n=39: 25 females and 14 males) studying an advanced clinical course. All students enrolled in the course were invited to participate in the study; a convenience sample

of participants from the course was studied. These students had been exposed to five previous courses that used an end-of-semester simulation-based assessment.

Two focus groups, of 1-hour duration with eight participants, were conducted before and after (teaching weeks 2 and 14) exposure to the teaching intervention to gather student insights into RQ1 and RQ2. In addition, a self-administered, anonymous voluntary online questionnaire was conducted three times during the semester (Appendix 1) after each of the three SCA rounds to explore RQ1 to RQ4. The survey consisted of three demographic questions, 21 five-point Likert-scale questions evaluating the students' perceptions, and opportunity to comment about the difficulties in learning to apply clinical interventions. The survey was presented to students before (teaching week 1) and after (teaching weeks 4 and 13) the new learning design had been experienced. The first survey (the 'pre-survey') and the third survey (the 'post-survey') were both associated with a summative component with in the SCAs, but the second survey (the 'interim survey') was not associated with a summative SCA.

RQ1 was addressed through survey questions 1, 2, 4, 5, 6, 11 and 12. RQ2 was addressed through the focus group interviews, and survey questions 18 to 21 inclusive. RQ3 was addressed through the focus group interviews, and survey questions 7, 8, 9, 20 and 21. The fourth RQ was addressed through survey questions 3, 10 and 17.

The Likert-scale data were analysed by comparing the medians (Wilcoxon test) of responses from students who submitted both the pre-survey and the post-survey; that is, paired data were analysed. Analysing the paired data rather than all responses from the pre- and post-surveys reduced the sample size for the analysis, but the results are generally considered to be stronger, as paired analyses accommodate the differences in individual students (8) which can be substantial, and generally increase the statistical power of the tests. Data from the interim survey were not included in the analysis because the interim survey was not associated with a summative SCA, so the students who completed the interim survey would not necessarily be comparable to students who completed the survey associated with summative SCAs. Furthermore, because the interim survey was not associated with a summative SCA, the number of students completing the interim survey was much smaller than for the pre- and post-surveys (n=13), and the number of pairs available for analysis smaller still. Fisher's exact test was used to compare the responses from the Yes/No questions from the pre- and post-surveys. The qualitative data was thematically coded and analysed against the research question.

Ethics

This study has been approved by the USC HREC (approval number: HREC A/11/276).

Results

The online survey was available to complete for a week after each iteration of the SCA (two formative, one summative); students were surveyed using the survey in Appendix 1. Twenty-seven students (69% of the 39 class enrolments) answered the pre-survey and 24 (62%) students answered the post-survey (Table 1). Fourteen students completed both the pre- and post-surveys.

Students were asked to identify all the areas they considered to have a negative impact on their learning to apply clinical interventions (Table 2). The total number identifying difficulties with the SCA significantly reduced from the pre-survey to the post-survey (Fisher's test; p=0.05), suggesting the new teaching approach reduces the challenges students associate with the traditional teaching approach.

Table 1. Demographic information for the respondents to the pre- and post-surveys

		Pre-survey	Post-survey	Completed both
Gender	Male	11 (41%)	11 (46%)	7 (50%)
	Female	15 (56%)	13 (54%)	7 (50%)
Highest level of education				
Did not complete secondary		1 (4%)	2 (8%)	1 (7%)
Completed secondary		22 (81%)	20 (83%)	12 (86%)
Trade qualification		1 (4%)	1 (4%)	0 (0%)
University graduate		2 (7%)	1 (4%)	1 (7%)
Total		27 (69%)	24 (62%)	14 (36%)

Note: one participant in Survey 1 did not identify their demographic data - (gender; highest level of education) in the pre-survey, but completed the rest of the questions. The percentages in the body of the table are percentages of the total number responding to that survey. The percentages in the final row are percentages of the total number of students enrolled in the course.

Table 2. Number (percentage) of respondents in each survey indicating aspects of the SCA that cause them difficulties

	Pre-survey (n=27)	Post-survey (n=24)
Total identifying difficulties	17 (63%)	* 8 (33%)
Not enough time to practice	12 (44%)	7 (29%)
Not enough structure during lab sessions	5 (19%)	2 (8%)
Feel intimidated working in front of other people	11 (41%)	4 (17%)
I am unable to remember protocols	7 (26%)	2 (8%)

* Fisher's test p≤0.05

Discussion

The changes in the mean responses for the 14 students common to the pre- and post-surveys (Figure 2) show that, in almost every case, the post-intervention scores improved over the pre-intervention scores. The five areas in which a significant change was measured were: enjoying an SCA, perception that SCAs are beneficial, confidence in providing feedback, ability to communicate to healthcare workers, and confidence in providing scene leadership. Although changes in response to most questions were not statistically significant, the fact that almost all moved in the positive direction suggests global evidence that the intervention made a positive impact on

students' learning. The small sample sizes involved imply that only large effects sizes have been detected.

The results indicate improved student understanding of their professional role as students felt more confident in the following elements of paramedic practice: scene management (Q1), scene leadership (Q2), clinical management (Q3 and Q17), sitrep provision (Q4), ability to explain professional role of a paramedic (Q5 and Q6), processes for mitigating error (Q8), communication with patients, peers and other healthcare workers (Q10, Q11 and Q12), and ability to self-critique (Q15). The largest increase in perceived ability was in the area of scene leadership and communication with other healthcare workers.
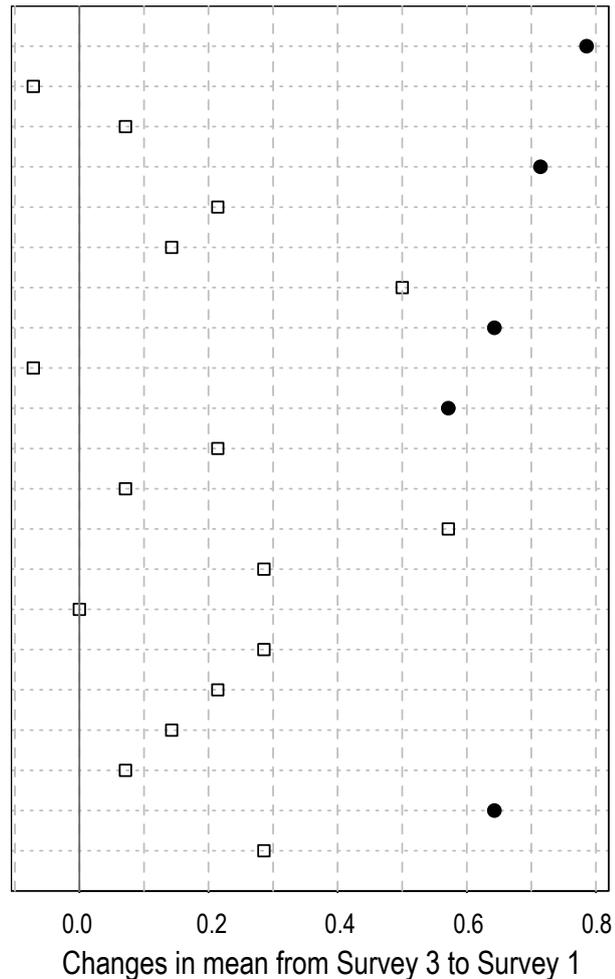
Changes over time

Figure 2. Change in the mean Likert-scale responses from the pre-survey to the post-survey for the 14 students who submitted both Survey 1 and 3. Items with filled circles are statistically significant at the 5% using a Wilcoxon (Mann-Whitney) test (p-values not adjusted for multiple testing). Items 19 (Feel nervous in graded OSCEs) and 20 (Am anxious in graded OSCEs) were reversed, so that positive values correspond to the interventions improving the student experience for all questions. The solid vertical line indicates no change. These previous SCAs were known to students as OSCEs, hence this terminology was used in the questionnaire to avoid confusion.

The questionnaire and focus group data indicated an improvement in the perception of the value of the SCAs in learning. Students reported enjoying the 'OSCEs' in the questionnaire (Q21) and in the focus group comments highlighting the value to learning and teaching include:

'I can't really think of anything bad about it. I agree with it as a formative assessment, I think it's useful, but the summative assessment is way too much pressure for me.'
And
'It's the best tool that I've had at uni doing this type of degree because I'm such a kinaesthetic learner.'

However, student perception of anxiety did not change and students still reported a similar response to being nervous in graded clinical assessments. The focus group data suggested students believe this was due to time-limited nature of the assessment and limited number of simulations. For example:
'Just the fact that I'd like to do more, like more time on it because I sort of found that even though they reduced the weighting of the OSCEs and they made it not a hurdle anymore

I still felt just as stressed about only having such a short amount of time. So I'd just like to do more to ease my anxiety a lot more, if I'd messed up one I had two more that I could do well in.'
The questionnaire data indicated a statistically significant increase in perception in students' ability to provide feedback but not in their ability to utilise feedback. Even though students felt they were able to better make judgements of other students' work against criteria, the focus group participants indicated a lack of value being placed in peer feedback. For example one participant stated:
'So in that regard, yes, I find it very useful watching a qualified person critique our peers, I learned from that, but not the other way around.'
In general however, focus group participants provided many positive responses concerning the value of the privileging of assessment roles. An example from peer assessment in the SCAs is:
'I found watching the scenario really useful, just seeing it from a different perspective and seeing things that you don't notice while you're doing the scenarios and that sort of thing, just as in the way you talk to the patient and where you position yourself

and things like that.'

In addition, the video critique exercise led to transformational learning, such as:

'The video was the same, watching yourself was good because you go - wow, I didn't realise I do that, or I realise now I use my hands a lot.'

And

'Considering the limited time we get with real patients, it's the best way to bring what you learn into what you actually do as a paramedic.'

Benefits of the new strategy

The new learning design led to a reduction in the reporting of barriers to developing ability to apply clinical interventions. The reported rates in the questionnaire dropped from 63% to 33%. This approach of utilising assessment to drive development is supported in the higher education literature related to teaching, learning and assessment (2-4,9-15). The strategy of using an SCA as a teaching tool is supported in four ways (16). First the teaching SCA engages students in learning that is productive by using the SCA as a formative assessment throughout the semester, which is aligned to tutorial activities in order to develop higher-order thinking. Deep learning is further encouraged by using authentic simulation tasks that mirrors professional practices (17). This teaching approach inducts the students into the SCA process by using self and peer assessment in a formative manner. This may have contributed to a lowering of anxiety associated with SCAs and an increased understanding of professional role.

Second, feedback is used to actively improve student learning through being an intrinsic part of the formative and summative activities. Indeed, in the learning design the peer, self and practitioner focused feedback is regularly provided in a supportive, specific, timely and informative manner to facilitate improved learning (2,9).

Third, students and teachers become responsible partners in learning and assessment. Assessment activities and standards require interpretation if they are to be understood (2,9). To improve students' participation, the new teaching approach includes privileging students an active and responsible role in assessment. This new teaching strategy manages the assessment processes with a partnership focus across the semester toward understanding evidence of performance rather than a teacher-centred focus only at the conclusion of the course.

Finally, assessment for learning is placed at the centre of subject and program design. An SCA designed with the intention being for learning will contribute directly to the way students approach their study and therefore be a powerful contributor to the quality of learning. Traditionally the SCA is not considered a part of student learning from the outset of the course nor embedded into the teaching of the curriculum. A distinct lack of utilising assessment 'as learning' and 'for learning' may contribute to poor alignment of the curriculum (16). When the

SCA is used as formative assessment as well as summative it should provide a context for deeper learning (18). The new learning design is being developed to systematically reflect this requirement by, firstly, transforming assessment tools from checklists with global ratings to criterion-based assessments in which the criteria will be made available to students in class activities that will explore these in detail; and secondly, provide feedback after the formal SCA incorporating video footage and grading notes to facilitate reflection.

Limitations of this study

The limitation to this study is the low number of participants. Increased numbers of participants and sites would provide a clearer understanding of this pedagogy and its effect on students' performance and anxiety. A further limitation is that students volunteered to participate in the focus groups and the survey. In addition, the data have been gathered from one instance of using the new method without comparing the results to those from using the former teaching method as a reference point. Nonetheless, the collected data reflects positive outcomes that support the educational theory that deep student learning is improved.

Conclusion

A body of evidence from allied health disciplines suggests the SCA or OSCE could be a powerful motivator of learning practical skills if conducted for the benefit of learning and should dramatically improve patient safety in the high-risk area of paramedicine. The data from this pilot project has demonstrated that requiring students to have an active role in learning activities by integrating the SCA into the teaching design has improved student confidence and understanding. This is due to students being aware of their learning goals and having to be actively involved in the strategies in place to reach them.

The focus on deep learning in the new learning design provides opportunities for students to self-monitor, rehearse, practise and receive feedback. Testing the new approach to SCA is particularly important within paramedic science programs whose frequently innovative and varied interpretation of the 'original' OSCE model (19,20) distances it from much of the existing evidence base and has not been significantly studied. The SCA used for learning has the potential to be a signature means for clinical educators to encourage and guide learning in paramedic science.

Acknowledgement

Competing interests

The authors declare they have no competing interests. Each author has completed the ICMJE conflict of interest statement.

Appendix 1. The online survey

Students responded to the following 21 questions on five-point Likert scale from: strongly disagree to strongly agree with the neutral position of neither agree or disagree. The questions asked were:

Q1   I am able to provide scene management.
Q2   I am able to provide scene leadership.
Q3   I am able to provide clinical management.
Q4   I am able to provide a sitrep to a third party.
Q5   I am able to clearly explain my professional role as a paramedic.
Q6   I am able to concisely explain my professional role as a paramedic.
Q7   I can explain the role that paramedic interventions play in the treatment of patients.
Q8   I understand the processes paramedics use for mitigating error.
Q9   Regarding the OSCEs, I can explain the relationship between the marking criteria and how it relates to clinical performance.
Q10   I am able to effectively communicate with patients.
Q11   I am able to effectively communicate with my paramedic partner.
Q12   I am able to effectively communicate with other health care workers.
Q13   I have the ability to constructively use feedback.
Q14   I have the ability to provide appropriate feedback to other paramedic students.
Q15   I have the ability to critique my clinical performance.
Q16   I am able to make judgements of other peoples' work based on the provided assessment criteria.
Q17   I am able to clinically assess a patient to plan evidence based interventions.
Q18   I consider participating in the OSCE process to be beneficial to my learning
Q19   I feel nervous when I participate in the graded end-of-semester OSCE.
Q20   I am anxious about participating in graded end-of-semester OSCEs.
Q21   I enjoy participating in the graded end-of-semester OSCE.

Students responded to the following six questions and provided extra comments.
For each of the following questions please indicate the most appropriate answer and provide additional comments if appropriate

Q22 Do you encounter difficulties in learning to apply clinical interventions?
A.   Yes – please complete questions 22 and 23
B.   No – please go to question 24
Q23 Please indicate all the areas that you consider to have a negative impact on your learning to apply clinical interventions.
A.   Not enough time to practice
B.   Not enough structure during laboratory sessions
C.   Feel intimidated working in front of other people
D.   I am unable to remember protocols
E.   Other __Please provide comments.
Q24 Has the use of ungraded OSCEs during the semester assisted in overcoming the issues highlighted in Q23?
A.   Yes
B.   No
Q25 Were you a full time secondary school student in 2010?
A.   Yes
B.   No
Q26 What is your gender?
A.   Male
B.   Female
Q27 Please indicate your highest completed level of education.
A.   Did not complete secondary school
B.   Completed secondary school
C.   Trade qualification
D.   University graduate.

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