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INNOVATION, IMPLEMENTATION, IMPROVEMENT

THE CLINICAL TEACHER

New approach to undergraduate quality improvement

Callum Robertson[1,2,3,4] | Keenan Smith[1] | Andrew McGowan[1] | Thomas Sammut[2] | James G. Boyle[3,4]

[1]University Hospital Crosshouse, Kilmarnock, Scotland

[2]University Hospital Ayr, Ayr, Scotland

[3]Glasgow Royal Infirmary, Glasgow, Scotland

[4]School of Medicine, Dentistry and Nursing, Wolfson Medical School Building, University of Glasgow, Glasgow, Scotland

Correspondence
Callum Robertson, Glasgow Royal Infirmary, 84 Castle Street, Glasgow, G4 0SF, UK.
Email: callum.robertson@glasgow.ac.uk

Funding information
University of Glasgow

Abstract

Background: While quality improvement (QI) is an essential component to modern day clinical practice, some foundation doctors fail to engage. This is compounded by a lack of formalised undergraduate QI teaching. We trial an undergraduate active learning workshop and evaluate it using a concurrent triangulation mixed methods design.

Approach: We constructed a 2-hour interactive QI workshop utilising near-peer educators for third year undergraduate medical students. Our workshop demonstrated an exemplary project and a template featuring evidenced-based QI tools to grasp key concepts. Informal support was provided for student QI projects, undertaken in small peer groups. Utility was assessed using linked pre-and-post event questionnaires with Likert scales, free text thematic analysis and project completion rates.

Evaluation: We recruited 74 students to attend our workshops delivered over 3 months. We achieved high event satisfaction and significant improvements on baseline confidence. Free text comments suggested students perceive QI as an important part of the undergraduate curriculum, described barriers to engagement and the value they place on project autonomy. The workshop eased student feelings of anxiety and intimidation regarding change ideas. Nine projects were completed with one winning a poster prize at a regional conference.

Implications: We demonstrate a popular resource light model that can be scaled up to a variety of centres. Targeting QI teaching at the undergraduate level may be instrumental in developing QI culture in health care systems and address barriers to postgraduate involvement. Our study furthers the understanding of undergraduate students' perspectives of QI and demand for further sessions.

Abbreviations: MFIF, Model for Improvement framework; NES, National Health Service Education for Scotland; PDSA, Plan-Do-Study-Act; QI, Quality Improvement; SMART, Specific-Measurable-Aligned-Realistic-Timebound.

1 | BACKGROUND

Quality improvement (QI) offers a systematic approach to enhance patient experience, system efficacy and health outcomes using evidenced-based methods to promote sustained change (1). In the UK, although QI is an essential competency-based component of postgraduate education, some clinicians fail to engage (2). Proposed barriers include knowledge, change reluctance and misconceptions discouraging peer team approaches (2).

QI methodology is not universally taught in undergraduate education (1, 3). Existing programmes offer constructivist approaches, centring learners as active participants with real-world application (3–6). Although popular with students, translation to practice is unclear (3–5). Sustained QI change has been demonstrated by undergraduates, but such models may be challenging to implement due to high faculty requirement and significant student time commitment (4). An effective faculty light design and concise constructivist derived QI workshop has yet to be studied in the literature.

To address perceived barriers to postgraduate QI, we created an undergraduate workshop to engage students in small local projects utilising junior doctors as near-peer educators. Near-peer education minimises faculty requirement while maintaining efficacy if supportive adjuncts are used (7, 8). An additional benefit is scaffolded learning where students can achieve greater content processing through teaching tailored to learners' perceived level (9, 10). To facilitate project work, a collaborative peer-peer approach was utilised to optimise individual workload (7, 8). Our constructivist near-peer QI workshop was designed and evaluated alongside the following questions:

- Q1: In what way does a near-peer delivered QI workshop affect students' views of QI?
- Q2: After a near-peer delivered QI workshop, would students engage and complete local QI projects during their clinical placement?

2 | APPROACH

QI is a broad subject with an array of tools and complex terminology (1, 2). Our goal was to impart the minimum required knowledge to undertake a local QI project. This approach utilises cognitive load theory, a philosophy that our working memory is finite and once exhausted no meaningful learning occurs (11). By focusing teaching, we limit extraneous information, facilitate knowledge retention and maintain clinical exposure.

To align our course, we approached the National Health Service Education for Scotland (NES) who have an established postgraduate QI framework (12). Through consensus, we agreed to cover the model for improvement framework (MFIF), Specific-Measurable-Aligned-Realistic-Timebound ('SMART') acronyms, cause-and-effect diagrams and Plan-Do-Study-Act (PDSA) cycles during a 2-hour QI workshop as described in Figure 1 (12–14). The MFIF asks structured questions to establish project aims, measures and change ideas linked to PDSA cycles to systematically analyse and improve systems.

The workshop was delivered to third year medical students completing their early clinical placements at the University of Glasgow (UoG) across NHS Ayrshire and Arran (NHS A&A) hospitals. There was no formal QI education in the UoG syllabus at the time of this initiative, and students rarely participated in QI out-with-short-lived student selected components (SSCs). Workshop groups were split to maintain small group dynamics with class sizes of 12-14 students.

To promote scaffolded learning, the workshop was structured around an exemplar to demonstrate real-world application. Two small-group breakout sessions followed exploring critical thinking and QI misconceptions. These sessions used cause-and-effect and PDSA templates with a choice of sample projects inspired from departmental morbidity and mortality meetings. Students were advised, if they wished to complete an optional QI project, to approach near-peer facilitators in small groups. Appreciating clinical commitments of the near-peer team support was offered as group discussion around completed templates or signposting to change resources.

Near-peer junior doctor facilitators had previously completed QI projects within NHS A&A. They received a 1-hour session covering slides and templates, with informal support thereafter.

3 | EVALUATION

To assess the value students placed on QI teaching, we used a concurrent triangulation mixed methods design, collecting quantitative and qualitative data in the same survey. Ethical approval was granted from the UoG ethics committee. Students completed pre-and-post event surveys, adapted from a local established teaching tool, collected anonymously at session end. Questions included self-rated confidence, learning outcome attainment and prompted free text comments ('What did you like about the session?' and 'How could we improve the session?'). Near-peers answered a single free text reflective question (supporting information S1).

For qualitative analysis, we utilised Braun and Clarke's reflexive thematic analysis (15). This involved coding free text comments of a single data set and developing themes to best capture reoccurring fundamental concepts through author consensus. We undertook an inductive methodological approach to represent our data's explicit content (15).

To address our second research question, if students engaged after teaching, we approached the organisers of a regional QI conference to flag submitted projects for review.

The IBM SPSS Statistics Package (Version 27) was used to assess quantitative data. Two-tailed paired t-tests assessed linked confidence levels and learning outcome competence, alongside mean and standard deviations. P values <0.05 represent a statistically significant finding.

FIGURE 1 Nine-step instructional design lesson plan.

Gagne's 9 Step Instructional Design(14)	
Gaining Attention **(10 minutes)**	To begin the session, the instructors launch a PowerPoint presentation and introduce the faculty. Our slides introduce a recently completed QI project. This should evoke an emotional response to encourage QI buy-in.
Informing learners of the **learning objectives**	Whilst several aspects are part of the hidden curriculum (team working, problem solving and reflective learning) the learning outcomes described are: • To discuss the importance of project planning • Use the Cause-and-Effect diagram to plan a sample project • To utilise a PDSA cycle in your own QI project
Stimulating recall of **previous learning**	Before expanding on the exemplar project, the audience are engaged to discuss their own experience of QI. This is reinforced in participant questions when discussing Cause-and-Effect diagrams(13-14).
Presenting the stimulus **(50 minutes)**	This session then introduces the exemplar project, we used a 3 PDSA cycle QI project designed to improve the safety of NG tubes in critically ill patients at a DGH. It is described using the SMART acronym (Specific, Measurable, Aligned, Realistic Timebound) for project aims, with a brief explanation on the common pitfalls on project planning(13-14). The Cause-and-Effect diagram is introduced explaining the theory of project planning(13) using the exemplar. Our intention is to demonstrate project resilience by considering multiple change ideas. Our next slide provides six sample projects specific to the student cohort and institutional directives to offer a variety of approaches and encourage student autonomy e.g. improve discharge planning, patient satisfaction with ward round information, patient satisfaction with pain control, infection control, delirium and thromboprophylaxis prescribing. Students select one of these topics and complete a Cause-and-Effect template in groups of 3-4. After this interactive break, we introduce the PDSA cycle(13-14). This reiterates the importance of reflective learning. Anecdotes from the exemplar project are used to illustrate challenges. The exemplar project is then discussed over 3 PDSA cycles using a train of thought conversationalist style. Our aim is to reduce anxiety in students by demonstrating a simple change idea achievable to the students. This completes the final stages of the project highlighting the conclusion and action plan the author will use on future projects. To conclude, a final interactive discussion utilising a PDSA template for their chosen project topic.
Providing Learning **Guidance**	Our exemplar project aims to provide learner guidance to engage with Cause-and-Effect diagram and PDSA templates. Faculty will rotate round groups to discuss diagrams and ideas.
Eliciting Performance and **Providing Feedback**	Faculty rotate offering different perspectives and challenging students' ideas at different stages of their conceptual project ideas, challenging any misconceptions.
Assessing Performance, **Enhancing Retention and** **Transfer (60 minutes)**	Work on the project templates is the primary means of assessing performance. Students unable to complete the diagram or failing to grasp the core topics will be asked to attend remedial training. Projects can be voluntarily completed by students. At the end of the session students are given the contact details for faculty and encouraged to inform if starting a project. Informal support could include signposting resources/facilities for change ideas e.g., poster printing. As a goal, the upcoming regional QI conference will be highlighted as a potential platform to present their work.

4 | RESULTS

Seventy-four students attended and completed both evaluation forms(63% of students) with seven indicating prior QI engagement(9%).

Q1: In what way does a near-peer delivered QI workshop affect students' views of QI?

Student confidence levels to undertake a QI project increased from a mean of 2.88[SD 1.57] to 7.84[SD 1.10, $p < 0.01$). A median student satisfaction rate of 5/5 was achieved. Significant improvement was noted in all learning outcomes (Table 1).

In the survey question 'I feel there is a need for QI teaching in the undergraduate curriculum', the mean value improved from 3.89 to 4.77($p < 0.01$) after teaching.

Table 2 demonstrates thematic analysis themes, sub-themes and coding from student comments. Core themes included:

'What students want from QI' (Table 3, quotes 1–5).

Students expressed interest in QI, its wider implications for patient care and autonomy in selecting projects. A core belief was that all actions should be patient centric with a transparent application to improving patient care. Using real-project examples was valued positively alongside the workshop's interactivity.

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TABLE 1 Student pre-and-post-teaching Likert scale survey results.

Likert scale question	Pre-teaching—mean value (1—strongly disagree, 5—strongly agree)	Post-teaching—mean value (1—strongly disagree, 5—strongly agree)
I understand why planning a QI project is important	3.18	4.77*
I understand that human factors can influence quality improvement	3.21	4.73*
I understand the basics of a PDSA cycle	1.09	4.53*

Note: $n = 74$.
*$P < 0.01$.

TABLE 2 Student thematic analysis—themes and coding.

Theme: What students want from QI
Subtheme: What students want projects to be
(Coding)
Solution to real problem
Relevant to their experience
Patient centred
Improving patient care
Project autonomy—own ideas
Sub theme: Perceptions of required support
(Coding)
Trainee: Teacher ratio
Feedback
Supervision
Role models
Theme: Challenges to students engaging in QI
Subtheme: Role within clinical team
(Coding)
Perceived too junior
Intimidated by senior consultants
Not qualified to interfere
Lack of clinical experience
Subtheme: Feasibility
(Coding)
Perceived as lots of work
Competing priorities
Complicated/technically challenging
Fear of failure—Need for positive results
Theme: The role of QI as a doctor
(Coding)
Role models
Essential/relevant
Additional skills required (presentation, statistics)

Students appreciate the value of supervision, expressing suggestions for trainee:teacher ratios to facilitate project work. Undoubtedly, this underpins the challenges of modern day clinical practice with some students implying existing nuances with clinical supervisors. Near-peers acted as role models, providing support and motivation, suggesting exposure challenged QI anxiety.

'Challenges to students engaging in QI' (Table 3, quotes 6–8).

QI was initially described with negative tones such as 'daunting' or 'scary'. Challenges to engagement included lack of knowledge and perceptions of being too junior to contribute meaningfully. After workshop teaching, students suggested QI was more accessible.

TABLE 3 Quotes 1–11 from thematic analysis.

'What students want from QI'	
1.	'It was really useful to have a worked through example and pre-formed topics at the end. Really engaging as it helped create solutions to problems we have seen ourselves!'
2.	'Would be good if we had QI supervisors too… loved the interactive content and 1-2-1 attention that I really needed to start.'
3.	'Group work with help from xxx was great, gave me the confidence to try and improve patient care.'
4.	'Really useful structure deployed, the teacher clearly had enthusiasm and values shown through, really appreciated it. Encouraged me towards completing a project.'
5.	'Loved the example project xxx did…Made me want to try a QI on the ward.'
'Challenges to students engaging in QI'	
6.	'…asking us to work through an example seemed scary at first but actually the premise is quite straightforward…quickly builds confidence.'
7.	'I think working through the fishbone diagram and PDSA cycles were great. Interactive and boosted confidence. If we were given an example to work through that we were sure was possible it would be good to practice it before trying to think if the project itself were feasible.'
8.	'Great, clear. Explained at a level relevant to 3rd year students. It would be good to join projects that will work, if it's not going well I don't know if I would lose motivation…'
'The Role of QI as a Doctor	
9.	'…So helpful since I want to get involved but don't know how - it is so so necessary to undergraduate teaching.'
10.	'First ever QI teaching - feel like QI teaching should be covered more throughout the curriculum.'
11.	'…QI sounds like it is every bit as useful to the junior doctor as the anatomy of the heart…'

Challenges to engagement included lack of knowledge and perceptions of being too junior to contribute meaningfully.

Students recognised that QI can be a significant amount of work and competing priorities, such as work-based assessments and limit engagement. Some were concerned that unsuccessful projects would affect their learning enthusiasm. Facilitating realistic project goals may offset negative repercussions associated with overambitious projects.

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'The Role of QI as a Doctor' (Table 3, quotes 9–11).

Students suggested QI could be as valuable as clinical skills in improving patient outcomes. In addition, multiple associated skills were viewed as essential including data analysis and presentation/publication of projects.

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There was an appreciation that QI should be taught throughout medical school and introduced prior to clinical placements. The concept of pre-placement education is interesting but perhaps challenging to implement in pre-clinical years with the paramount focus in-achieving a core grasp of medical science.

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Q2: Would students engage and complete local QI projects during their clinical placement?

After teaching, 12 groups of students approached faculty with potential projects. Four of these did not persist past the planning stage, citing proximity to examinations as a contributing factor. Nine student projects (Table 4) were accepted to the regional conference with one winning a poster prize. Organiser feedback suggested that abstracts were of mixed quality and several required writing style coaching before acceptance.

TABLE 4 Student project summary.

Number of students	Support	Summary of project	Number of completed PDSA cycles
3	Near-peer faculty	A project to reduce fall rates in the medical wards, PDSA cycles focused on the 4-AT delirium score, including educational sessions and materials for 2 wards.	3
4	Near-peer faculty	A project to improve patient safety and sedation requirements on surgical wards utilising the 4-AT bundle. This included educational sessions, materials and stickers for two wards.	3
3	Near-peer faculty	A project to improve safety of staff rotating into ITU using vasopressors. This included educational sessions and materials.	2
4	Near-peer faculty	A project to improve PPE compliance of staff completing procedures on two medical wards. This included educational materials, educational sessions, and arrangement of PPE stations for staff. This notably won a poster prize.	3
4	Near-peer faculty	A project to improve peripheral cannula insertion safety, this included educational materials, educational sessions and a revised cannula bundle available as a sticker to be used for the notes	2
3	Near-peer faculty	In response to an M&M meeting, this project aimed to improve the action taken on patients flagged at risk from 4-AT scoring on two surgical wards. This included educational sessions and materials around the TIME bundle.	2
4	Near-peer faculty	Ward note legibility, a project with aims to reduce delays to medical treatment due to miscommunication. This included the launch of a ward round sticker proforma for the notes for action plans.	2
3	Near-peer faculty	To improve the documentation quality of arterial cannulas in the medical high care department and reduce risk of infection. This group produced a sticker proforma that could be completed and attached to the notes before delivering an education session during PDSA 2.	2
2	Junior doctor independent from faculty	Medical reconciliation, a project looking at the rate of errors in medical reconciliation in receiving wards	2

5 | IMPLICATIONS

Our 2-hour near-peer workshop demonstrates a faculty light and time-efficient method of introducing QI into undergraduate curricula with evidence of knowledge transition into practice. Students supported high satisfaction, improvements in confidence and learning attainment. Mutual benefits were noted from near-peers, citing improvements in self-perceived QI knowledge.

Our baseline commentary suggested that students found QI intimidating. The workshop demonstrated change in tone regarding project feasibility, student's role in QI and motivation. Thematic analysis suggests that near-peers were readily identified as QI role-models, perhaps influencing project uptake and confidence. McGeorge et al. supports this observation, suggesting that students prefer QI teaching from peers/near-peers in contrast to subject experts (3).

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After the QI workshop, students desired early curricula integration and teaching on complementary subjects including academic writing. This was supported by the writing style coaching offered by conference organisers. We found this insightful, highlighting perceived learning gaps and opportunities for future workshops not readily discussed in QI literature.

Thirty students completed QI projects with informal near-peer support, achieving a poster prize and nine presentations. This may be an under-representation as students were not followed-up on subsequent placements. Although a direct assessment of competence was not made, all projects described at least two PDSA cycles, evidencing consideration of QI methodology (4, 5).

While students discussed feasibility and motivation as challenges to engaging in QI, they also expressed ideas on what they would value in a QI project, including project autonomy and hands-on experience. In this context, we believe there is low acceptability for 'dry' projects primarily utilising historical data with limited patient contact. We suggest that future work explore how we present QI projects to students to support meaningful engagement.

AUTHOR CONTRIBUTIONS

C. Robertson—Substantial contributions to the conception and design of the work including the acquisition, analysis and interpretation of data AND drafting the work including revision for important intellectual content AND final approval of the version to be published AND agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

K. Smith—Substantial contributions to the conception and design of the work including the acquisition, analysis and interpretation of data AND drafting the work including revision for important intellectual content AND final approval of the version to be published AND agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

A. McGowan—Substantial contributions to the conception and design of the work including the acquisition, analysis and interpretation of data AND drafting the work including revision for important intellectual content AND final approval of the version to be published AND agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

T. Sammut—Substantial contributions to the conception and design of the work including the acquisition of data AND final approval of the version to be published AND agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest to disclose.

ETHICAL APPROVAL

Ethical approval was gained from the University of Glasgow ethics committee with application number 200200166. We consulted the NHS Health Research Authority REC decision tool which confirmed that formal NHS REC review was not required for the purposes of this study.

ORCID

Callum Robertson https://orcid.org/0000-0003-3570-182X
James G. Boyle https://orcid.org/0000-0002-6280-0105

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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