

Learning and Peer Feedback in Undergraduate Medical Student Simulation

Amy Turnbull ^{1,2,*}, Lydia Shackshaft ^{1,2,*}, Katie Ash ^{1,2}, Emma Furzer ^{1,2}, Alexandra G Martin^{1,2}

¹Bristol Medical School, University of Bristol, Bristol, UK; ²Medical Education, University Hospitals Bristol and Weston NHS Foundation Trust, Bristol, UK

*These authors contributed equally to this work

Correspondence: Amy Turnbull, Bristol Medical School, University of Bristol, 1st Floor 39 Whatley Road, Bristol, BS8 2PS, UK, Email amy.turnbull@bristol.ac.uk

Purpose: Simulation-based teaching is an integral part of medical training, providing the opportunity to apply clinical knowledge in a realistic yet controlled environment. The proportion of observers to active participants in the simulation is increasing, owing to the increasing number of medical students. Evidence suggests that using an observer tool can enhance learning, support debriefing and improve observer satisfaction. However, there is a lack of generalisable observer tools designed for use across different simulation scenarios, including both technical and nontechnical skills. We aimed to evaluate the acceptability and perceived usefulness of our novel observer tool and its impact on learning and peer feedback in a medical-student simulation.

Methods: We delivered a simulation series to 43 medical students in which observers of simulation completed our CARSEAT observer tool, an acronym for Communication, A-E assessment, Rapport, Situational awareness, Escalation, Application of clinical knowledge, and Teamwork. The participants completed the pre- and post-intervention questionnaires. The study used an unpaired pre-/post- intervention design, with 38 pre- and 34 post-survey respondents. Primary outcomes were perceived usefulness, engagement, and impact on learning and feedback. Descriptive statistics were used for quantitative data, and qualitative data were analysed thematically.

Results: 94% of respondents found observing simulation more useful when using the tool than without. The majority agreed that the tool improved aspects of learning and peer feedback. Thematic analysis identified six major themes: (1) impressions of observation, (2) engagement during observation, (3) enhancement of learning, (4) providing peer feedback, (5) useful aspects of the CARSEAT tool, and (6) suggested improvements for the CARSEAT tool.

Conclusion: Our novel observer tool improved engagement, enhanced learning, and supported peer feedback during the medical student simulation sessions. The tool's structure and clear domains make it easy to use and generalise across different simulation scenarios, with potential for integration into undergraduate curricula, and wider implementation across institutions.

Keywords: simulation, observer tool, feedback, undergraduate, medical education, observer role

Introduction

Simulation-based teaching (SBT) is a valuable component of medical training and has been increasingly adopted worldwide.¹ It provides a unique opportunity for medical students to experience clinical scenarios in a realistic yet safe environment. SBT facilitates the development of knowledge and complex skills² while preventing unnecessary risks to patients and ultimately improving clinical outcomes.¹ Immersive experience supports experiential learning, as outlined by Kolb's experiential learning cycle, thus bridging the gap between theoretical knowledge and clinical practice.³ Moreover, SBT is highly valued by medical students, who report benefits for skill acquisition and confidence.⁴

Since its origins in resuscitation training in the 1960s, SBT in healthcare education has expanded dramatically.⁵ Its scope has evolved with advances in technology and medical knowledge^{6,7} supported by evidence for effective instructional design.⁸ However, high-fidelity simulation is resource intensive.⁶ Increasing numbers of medical students⁹ without a proportionate rise in educators or resources¹⁰ means more students now engage in simulation as observers rather than active participants.

However, the role of observers in SBT for medical students and their impact on learning outcomes is poorly defined. Bandura's social learning theory advocates that experiential learning can almost always be acquired vicariously by observing others' behaviours and their consequences.¹¹ This suggests that participation in SBT through direct observation of others can enhance learning. However, despite an excess of evidence comparing the elements of SBT,⁸ there is limited research on the observer's role.

Emerging evidence suggests that observing simulations may benefit learning through active participation. A recent randomised controlled trial of emergency medicine residents showed that observing a skills-based simulation session followed by debriefing was as beneficial to learning as active participation in the scenario.¹² This is supported by another study of anaesthesia residents, which found no difference in learning between active participation and observation.¹³ Similarly, a study of nursing and medical students found no significant difference between the learning of non-technical skills in observers and active participants in SBT.¹⁴ This suggests a clear underestimation of the benefits of observing a simulation.

Given these apparent benefits, it is important to consider how learning can be optimised for students in an observer's role. Currently, there is a paucity of evidence regarding the optimal strategies for engaging observers in SBT to enhance learning outcomes. In nursing students, the use of an observer tool to focus learners is strongly associated with role satisfaction and the achievement of learning outcomes.¹⁵ However, research on the use of observer tools by medical students is limited. One study found that a specific observation script helped to focus medical students' attention when observing doctor-patient communication, thereby facilitating vicarious learning.¹⁶ Another study used an observer checklist of scenario-specific technical skills among medical students, and despite no significant difference in global performance immediately after the simulation, their theoretical knowledge was significantly higher.¹⁷ These findings suggest that observer tools may improve engagement and learning in medical student SBT.

Observers also play a crucial role in debrief, in which feedback has been identified as the single most important element for effective learning in SBT.¹⁸ The quality and quantity of peer feedback from observers are inevitably related to their engagement. However, the role of the observer and the optimum way to engage students in debriefing sessions remain unclear. Using a structured feedback tool may be beneficial. One small study demonstrated increased student confidence in giving feedback and perceived learning gains from both giving and receiving feedback.¹⁹

However, existing tools typically address either technical or non-technical domains in isolation, despite these skills being interdependent in clinical practice. A single, generalisable tool encompassing both domains could provide a more holistic and realistic framework. To our knowledge, no such tool has been evaluated among medical students.

Therefore, this study aimed to evaluate the efficacy of the CARSEAT observer tool in improving perceived learning, observer engagement and the quality of peer feedback during undergraduate medical student simulation sessions. Unlike previous tools, the CARSEAT tool is generalisable across different scenarios and incorporates both technical and non-technical domains.

Materials and Methods

Context and Participants

This prospective single-group pre-test post-test mixed-methods study was conducted at a district general hospital in Southwest England where undergraduate medical students attend clinical placements. We designed a simulation series for each of the three year groups on placement. Each session lasted 2–3 hours and consisted of two different scenarios involving the management of acutely unwell patients, communication skills, and ethico-legal issues. They were tailored to the educational level of each group, and did not require students to perform practical procedural skills.

Simulation sessions were conducted in groups of 8–10 students; with 2–3 students actively participating in each scenario. The remaining students observed from a separate room using a live video conferencing software: on some occasions students described muffled audio quality, and frozen video or audio distortion due to high latency, but these were not felt to significantly impede their ability to observe the scenario. The students were asked to volunteer to take the role of active participants. All students were active participants and observers at least once during the series. Observers were instructed to watch the simulation scenarios carefully to support their own learning and to provide peer feedback on

both technical and non-technical skills. Paper copies of our novel structured observer tool (CARSEAT)(see The CARSEAT Observer Tool and [appendix 1](#)) were provided to all observers. They were asked to handwrite their observations of the active participants' behaviours and skills in relation to each domain in the tool. Additional briefing of observers was not standardised, but often included a reminder that they would be asked to share their written feedback in the subsequent scenario debrief, and encouragement to consider both positive and constructive feedback for each domain. A debriefing session followed each scenario: debriefs did not follow a standardised procedure, but incorporated elements of the iTrust debrief model developed by University Hospitals Bristol and Weston NHS Foundation Trust Simulation Centre as well as using the domains of the CARSEAT tool to facilitate structured discussion and feedback. All sessions were facilitated by members of the research team, all of whom were Clinical Teaching Fellows trained to deliver simulation sessions and provide feedback.

All third-, fourth-, and fifth (final) year students on clinical placement at the study site were invited to participate. There were no additional inclusion or exclusion criteria. A participant information sheet was provided and written consent was obtained from the students who chose to participate. Students were informed that there were possible but unknown benefits to their learning from participating but there were no additional incentives. Students who did not consent were not prevented from participating in the simulation sessions or using the CARSEAT observer tool. A total of 43 students were invited to participate, and all 43 consented. The participants were all undergraduate medical students (18 third-year, eight fourth-year, and 17 final-year students).

The CARSEAT Observer Tool

In this study, we developed the novel CARSEAT observer tool ([Appendix 1](#)). CARSEAT is an acronym for the domains within the tool that students observe during simulation: Communication, A-E assessment, Rapport, Situational awareness, Escalation, Application of clinical knowledge, and Teamwork. These reflect the key skills and competencies required for students to become safe doctors, derived from the General Medical Council's "Good Medical Practice",²⁰ the six competencies from the Accreditation Council for Graduate Medical Education,²¹ and our own experiences as medical professionals. The CARSEAT tool is a structured proforma for students to complete during the simulation session, with prompts to help clarify the definition of each domain and the skills or behaviours students should be observing. The conceptual framework and presentation of the tool were previously shared as conference slides.²²

Data Collection

Participants completed an online pre-intervention survey prior to the simulation. This consisted of three open-ended questions related to their views on observing peers in the simulation and providing peer feedback. Following the use of CARSEAT in the simulation series, participants completed an online post-intervention survey. This consisted of 5-point Likert scales and open-ended free-text questions to provide a deeper understanding of their views on observing peers in simulation and the use of CARSEAT. All responses were anonymous to encourage student participation, diverse viewpoints, and ensure credibility of findings in the context of a power imbalance between researchers and participants. This resulted in unpaired pre- and postintervention responses which consequently limited analyses to group-level differences and prevented analyses of within-participant change.

Data Analyses

Descriptive statistics were calculated for each Likert scale variable. Open-ended free-text questions were analysed thematically within a post-positivist paradigm, beginning with familiarisation with the data and inductive coding by AT. The codes were collated into a developing codebook by AT. A portion of the survey responses (n = 4 pre-intervention; n = 4 post-intervention) was independently coded by LS, KA, and EF using the developing codebook. This recognised potential differing interpretations of the data based on personal and professional backgrounds: all researchers were medical doctors and Clinical Teaching Fellows, but with varied experiences of facilitating the CARSEAT simulation sessions, and diverse personal experiences of participating in and observing simulations. Any differences in coding were discussed which involved reflecting on how the participant's use of language and researchers' backgrounds influenced their interpretation of the data. Different interpretations were discussed until consensus was reached amongst all coders of an appropriate code, or until agreement on modifying the codebook to better represent the data.

Initial themes were developed by AT and LS, followed by an iterative process of reviewing and refining themes and associated subthemes through discussions among AT, LS, KA, and EF. Sample size was largely determined by pragmatic considerations, namely recruitment of all eligible students during the current academic year; however, during inductive coding and theme development we assessed that inductive thematic saturation²³ had been reached and that our sample size was therefore sufficient.

Ethical Approval

Ethical approval was obtained from the Faculty of Health Sciences Research Ethics Committee of the University of Bristol (approval number: 22053). In addition to providing consent to participate, all participants gave consent for the publication of de-identified quotations in this manuscript. All quoted material has been reviewed to ensure that individuals are not identifiable.

Results

Between January and April 2025, 43 students used the CARSEAT across 23 simulation sessions.

Owing to differences in timetables and the timing of data collection, individual students used CARSEAT between one and six simulation sessions. The pre-intervention survey was completed by 38 students comprising 16 third-year, 6 fourth-year, and 16 final-year students (88.4% response rate) and post-intervention survey by 34 consisting of 16 third-year, 7 fourth-year, and 11 final-year students (79.1% response rate).

Quantitative Descriptive Analysis

Overall, the majority of students (32/34 students [94%]) reported finding it more useful observing simulations with the tool than without. CARSEAT was found to have self-reported benefits for learning, with the majority of respondents indicating in post-intervention surveys that it supported their understanding of clinical knowledge application (22/34 students [64.7%]), reflection on their communication skills (29/34 students [85.3%]), and was easy to use (29/34 students [85.3%]). It encouraged them to observe specific aspects of the simulation (28/34 students [82.3%]) and helped maintain engagement (29/34 students [85.3%]) (Figure 1).

Participants also reported the benefits of CARSEAT in their ability to provide peer feedback during debriefing sessions. The majority reported post-intervention that the tool gave them confidence in delivering feedback (24/34 students [70.6%]), helped them recognise aspects that needed improvement (25/34 students [73.5%]), and aspects performed well during the scenario (25/34 students [73.5%]), and provided a structure for delivering feedback (31/34 students [91.2%]) (Figure 2).

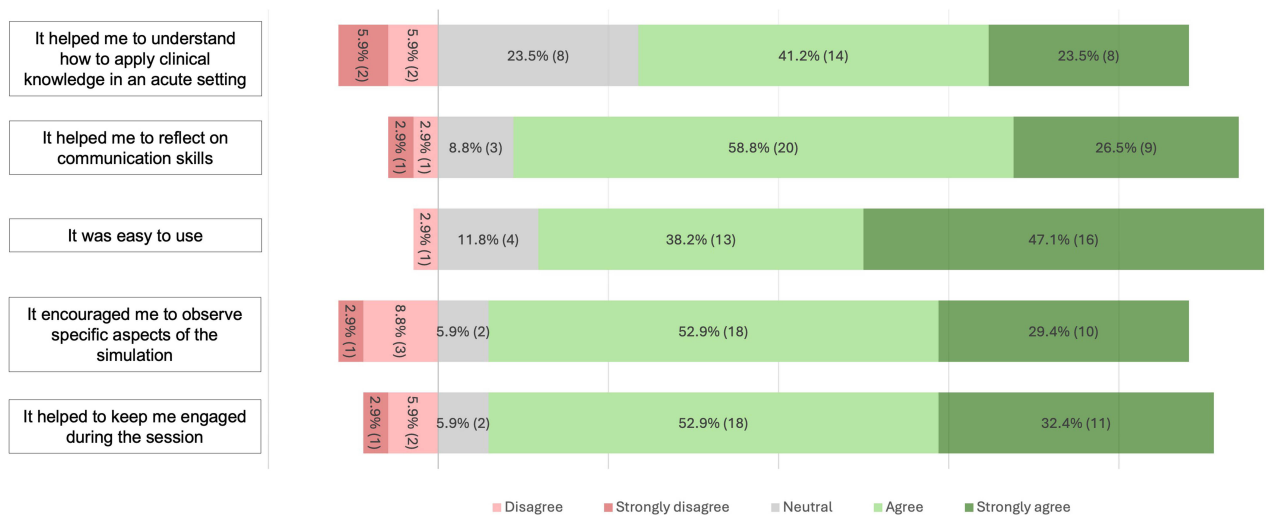


Figure 1 Post-intervention survey responses to 5-point Likert scale questions regarding impact of the CARSEAT observer tool on learning. Results displayed as both percentage and number of respondents.



Figure 2 Post-intervention survey responses to 5-point Likert scale questions regarding impact of the CARSEAT observer tool on providing peer feedback. Results displayed as both percentage and number of respondents.

Thematic Analysis

Through thematic analysis of the open-ended questions, we identified six major themes: (1) impressions of observation, (2) engagement during observation, (3) enhancement of learning, (4) providing peer feedback, (5) useful aspects of the CARSEAT tool, and (6) suggested improvements to the CARSEAT tool. The distinct but interacting nature of these six major themes, and associations with eight subthemes, are presented as a thematic map (Figure 3) and with illustrative participant quotes (Table 1).

Impressions of Observation

Participants described both positive and negative views of observing peers in simulation. Some found observation easier and less stressful than active participation, yet still a useful process which helped build their confidence: “I believe it is quite useful for my learning, as I can perceive the situation from the outside without the pressure of having to work through it myself”.

“I feel like it can sometimes help build your own confidence and give you an idea of what other people do well and not so well to take into our own sim.”

Some expressed a view that active participation is preferable, but observation is still useful: “I prefer to be participating actively but it’s still very valuable and I feel I learn tips and tricks from my peers”. However, others expressed mostly negative views about observing simulation, indicating that it is not a useful experience, does not contribute to their learning, and can introduce stress for those being observed: “It is a lot more boring... I don’t know how much I learnt about it via watching rather than doing” and it “can put that extra pressure if you feel that your group isn’t supportive”. Regardless of the initial impressions of observation, most respondents indicated that CARSEAT improved their experience as observers: “I think it is a great tool to aid observation and feedback” and “I find it more useful than being sat passively and watching”.

Engagement During Observation

The participants highlighted that it could be difficult to engage and concentrate when observing peers during the simulation sessions, which could limit their learning. Participants commented that observing simulation “can feel a bit boring” and that it “can be easy to get distracted”.

“I do learn when observing but I have to ensure that I engage and concentrate.”

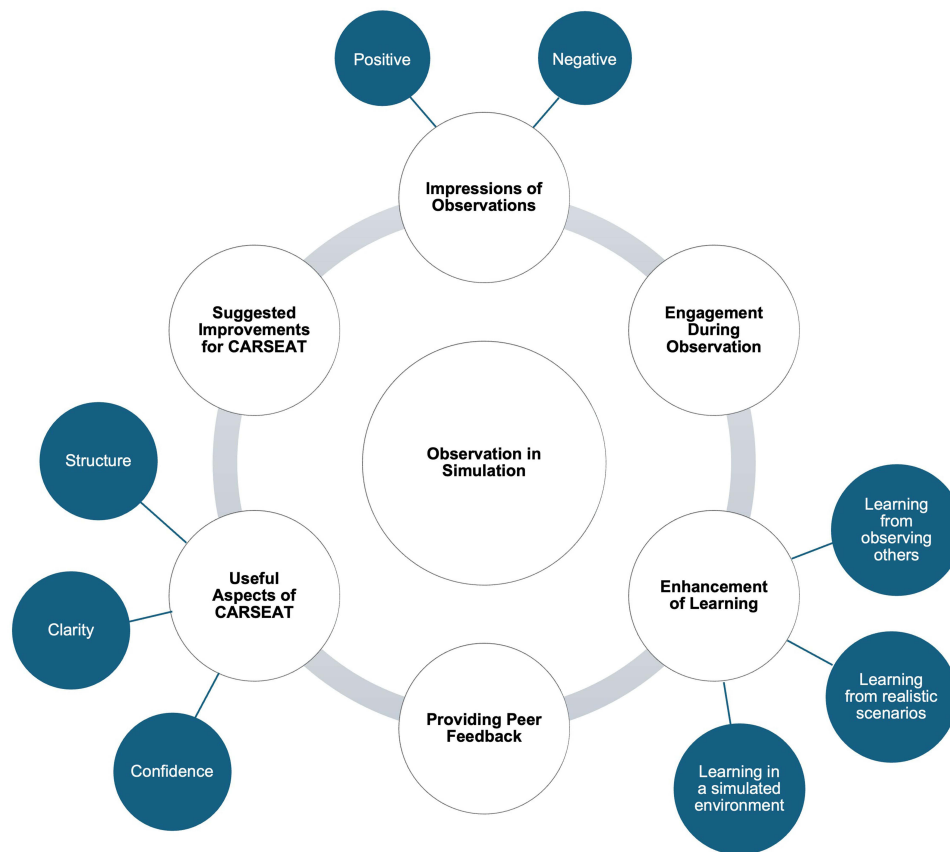


Figure 3 Thematic map demonstrating the six major themes identified and associated subthemes.

Post-intervention survey responses indicated that CARSEAT improves engagement: “it helped me be a more engaged observer” by “forcing you to focus”.

Enhancement of Learning

Participants indicated the benefits of observing peers in simulation for their learning. This can be broken down into the subthemes of learning from observing others, learning from realistic scenarios, and learning in a simulated environment (see [Figure 3](#)).

Observing peers was described as an opportunity to “pick up learning points from other students”, “get a different perspective”, and “reflect on your own practice”. It was described as a way to compare “how we would approach these scenarios and what we would do differently”. They identified learning by observing their peers’ strengths, weaknesses, and mistakes.

“It can help you to recognise what needs improvement and what is done well, which can help you to build upon your own skills when doing SIM.”

Observation was considered particularly useful because of the scenarios’ basis in realistic clinical scenarios which provide exposure to “practical situations which otherwise we don’t get experience of”. This offers an opportunity to revise prior knowledge and practice clinical reasoning skills, despite not actively participating: “[it] helps to consolidate knowledge on investigations and management or conditions”. Watching these realistic scenarios was felt to help situational awareness as “when you’re not actually there in the moment you can watch and think more clearly”. Learning in a simulated environment was felt to be a “good way to learn from others and make mistakes in a safe space”.

Table 1 The Six Major Themes Identified, Associated Subthemes, and Example Participant Quotes

Theme	Subtheme	Example Participant Quote
Impressions of Observation	Positive	"I feel that it is useful to observe others as it can be beneficial to both observers' learning and learning of those being observed"
	Negative	"It's [observation is] not very useful if it's all you're doing in a 3hr simulation session"
Engagement During Observation		"can be easy to get distracted whilst watching" "[CARSEAT] kept me engaged throughout sim"
Enhancement of Learning	Learning from observing others	"My peers are all very talented and have different experiences. Watching them allows me to implement aspects of their simulation skills to mine".
	Learning from realistic scenarios	"Good to see an emergency clinical scenario in action that you may not necessarily get to see on the wards until you graduate"
	Learning in a simulated environment	"Helps put to practice book knowledge"
Providing Peer Feedback		"Can be tricky to be objective and come up with constructive criticism" "it [CARSEAT] is a really good tool for giving constructive feedback"
Useful Aspects of CARSEAT	Structure	"[CARSEAT] gave a good structure to focus on when observing which then made it easier to give better feedback"
	Clarity	"Very clear and easy to use"
	Confidence	"I feel a bit more confident after using the carseat tool - it was easier for my own learning to pinpoint areas for improvement in my peers".
Suggested Improvements for CARSEAT		"Some of the criterion are very similar in my opinion / need further distinguishing / teaching on differences perhaps" "Fewer categories and the use of it during debrief would be better"

Providing Peer Feedback

Participants recognised the usefulness of receiving peer feedback: "it helps all of us learn from the scenario". For many this is a process that they described feeling indifferent or even positive about, and "comfortable doing". However, a significant number of participants described providing feedback as challenging, "a little bit awkward", and that providing constructive feedback is particularly difficult: "sometimes feels easier to give positive feedback than negative".

Post-intervention surveys highlighted participants' opinions that CARSEAT supports them by providing detailed structured feedback.

"The tool is very useful to allow you to know what to feedback on, give you some guidance on how to approach the feedback and ensure that every important aspect of observing the simulation is covered."

Useful Aspects of the CARSEAT Tool

Three specific aspects of CARSEAT were identified as particularly useful: structure, clarity, and impact on student confidence. Participants found the "clear framework for what to look out for when observing" and "clear sections with good headlines" beneficial for helping them focus and provide peer feedback (see 3.2.4). Participants expressed appreciation of having a physical tool which enables them to write comments whilst observing "which meant I didn't forget things I'd thought of by the end". The tool was found to increase students' confidence in identifying points of improvement in peer feedback.

Suggested Improvements for the CARSEAT Tool

Despite overarching positive viewpoints about CARSEAT, and many participants indicating no required improvements, two key areas for development were suggested. Firstly, many participants expressed that some domains overlap, particularly “communication” and “rapport”: “I think there could be fewer categories and less overlap”. Third-year students suggested that these “need further distinguishing/teaching on differences” or could be linked as “it’s hard to assess 7/8 categories at once when a simulation can be very hectic”. The second key suggestion was to improve the utilisation of CARSEAT during debriefs; a viewpoint only expressed by fourth-year students: “it’s not useful unless you then go through it in the debrief”.

Mixed-Methods Integration

Quantitative data demonstrated that 94% of students found it more useful observing simulation with the tool than without, while qualitative data provided rich insights into the reasons for this; namely, enhanced engagement, provision of clear domains to focus on while observing, and increased self-efficacy in providing structured peer feedback. Participants who reported fewer benefits of CARSEAT within quantitative data highlighted poor integration in the debrief as a key limitation within qualitative responses.

Discussion

Our analysis demonstrated that the CARSEAT observer tool is useful for improving engagement, enhancing learning, and facilitating peer feedback during medical student simulation sessions.

Respondents reported varied prior experiences of observation, in line with previous work demonstrating reduced stress²⁴ and improved role satisfaction,¹³ whereas others perceived it as a passive experience.¹⁵ Therefore, the observer’s role may be particularly beneficial to some students, enabling them to derive equivalent learning without a stressful, immersive experience. In contrast, a large meta-analysis of randomised controlled trials in healthcare simulation education suggested that active participation led to superior learning compared to observation; however, these trials did not use observer tools.²⁵ Some studies suggest that without guidance or clear objectives, observers may disengage or experience lower knowledge retention compared with active participants.²⁶ These findings underscore the importance of structured tools such as CARSEAT to optimise the observer role.

The high quantitative endorsement of CARSEAT – particularly in perceived engagement and confidence in giving feedback – was echoed in the qualitative themes of structure, clarity and confidence. This aligns with existing evidence that the use of an observer tool and clear role allocation improves observer role satisfaction and learning,¹⁵ including improved medical knowledge among resident doctors.²⁷ Therefore, our study adds to this body of evidence highlighting the benefits of using an observer tool and contributes novel findings regarding its impact on learning and feedback, specifically among undergraduate medical students.

Several aspects of CARSEAT have been highlighted as being particularly useful. Having a physical tool to complete promoted engagement; this is in line with the attention boost effect which suggests that attention is increased by performing two simultaneous actions.²⁸ The clear structure and specific domains were beneficial when providing peer feedback, an area where students can experience significant difficulties.²⁹ This is particularly important as giving peer feedback has been shown to improve learning and development of professionalism.³⁰ Our participants reported feeling more confident giving feedback with the tool and being more able to recognise both positive areas of peer performance and areas for improvement. This finding supports a recent study, which concluded that the use of an observation script can improve the accuracy of peer feedback.¹⁶

While the majority of respondents reported high engagement and perceived learning benefits, a small number noted elements of boredom and overlap between domains, such as communication and rapport. This opinion was mostly expressed by third-year students; therefore, it may be that these domains are more relevant in simulation scenarios with a greater emphasis on the doctor-patient relationship. Alternatively, given that Schön’s reflection model suggests reflection-on-action may be more effective for students with greater prior experience,³¹ CARSEAT may be more useful for later-year students.

Although structure appeared to enhance learning, the format risks encouraging a checklist-based approach, potentially limiting deeper reflection. Similarly, by directing attention to specific domains, observers may focus on discrete elements rather than developing a holistic view. Future developments could integrate open-ended prompts or reflective components to balance structure with clinical reasoning.

Limitations

A key limitation of our study was that the pre- and post-intervention questionnaires were not paired. This was necessary to maintain participant anonymity, avoid social desirability bias, and encourage honest responses despite the researchers' involvement in students' teaching. However, this meant that we were unable to directly compare individuals' pre- and post-responses.

Furthermore, there was no standardisation of how the tool was utilised by the faculty in the debriefing sessions across the simulation series between year groups. Participants were generally encouraged to write about both positive and constructive elements for each domain of the tool; however, this was not consistent across year groups and was not specified in the tool. This may have affected the students' experience of using the tool to provide feedback, as highlighted in participant responses. Outcomes were based on self-reported perceptions rather than objective measures of skill-acquisition; future studies incorporating objective performance would strengthen evidence of the tool's effectiveness.

Finally, the sample size (N=43) is modest, and the study was conducted at a single university's clinical placement site. Replication and dissemination on a larger scale may yield more generalisable results.

Conclusion

Our novel observer tool, CARSEAT, improves engagement, enhances learning, and supports peer feedback in undergraduate medical student simulation sessions. The structure, domain clarity, and positive impact on students' confidence made the tool useful and easy to use. CARSEAT has the potential for integration into routine simulation teaching and faculty development to support structured feedback. With further refinement, the tool could be scaled for wider use or adapted into a digital format to facilitate real-time completion.

Abbreviation

SBT, simulation-based teaching.

Data Sharing Statement

The data that support the findings of this study are available upon request from the corresponding author (AT). The data are not publicly available due to maintain participant confidentiality.

Ethics Approval and Informed Consent

Ethical approval was obtained from the Faculty of Health Sciences Research Ethics Committee of the University of Bristol (approval number: 22053). Written informed consent was obtained from all participants prior to their participation in the study.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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