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Educating for capability and preparing for practice: Integrating theory and skills

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Data Availability

All raw data used for the study is available on request.

Ethical Approval

Informed Consent

Informed consent was gained from each participant with provision of information sheets and consent form. The disadvantages and benefits of enrolment, as well as the right to withdraw at any stage was discussed.

Conflict of Interests

Permission to Reproduce Materials

All figures are original and belong to the corresponding author. Permission to publish the images was gained during the consent process.

Acknowledgements

ABSTRACT

Capability is the ability to perform clinical skills in ever-changing real world contexts, adapting to challenges and integrating technical and non-technical skills and competencies e.g. cannulating an uncooperative patient at night. Going beyond teaching competency and ensuring capability is imperative, as recommended by the national outcomes for medical graduates. A course on intravenous cannulation was developed with e-learning modules and high-fidelity complex simulation scenarios, aiming to promote capability in practice.

The course delivered an intravenous cannulation e-learning package between two practical simulations to ten final-year medical students. The hybrid simulation design consisted of an actor with a bespoke cannulation part-task trainer strapped to their arm. Each simulation delivered a challenging scenario, requiring the integration of procedural and behavioural skills to succeed. Simulations were video recorded, and participants reviewed their performances before completing semi-structured interviews. Transcribed interviews were thematically analyzed.

Interview analysis demonstrated two overarching themes: 'Impact on Capability' and 'Preparedness for Practice'. There was consistent recognition of improved capability from the interviews. Simulation exercises were described as the most valuable tool for developing capability. The e-learning helped with structure, facilitating students' adaptation to scenarios. Participants felt that training in medical school was largely competency-based and did not tackle complex interactions. Following e-learning and simulations, students felt more prepared for clinical practice.

The course structure has value for medical professionals in developing capability and preparing for clinical practice, helping to reach standards expected of graduates. Plans to

assess capability across multiple undergraduate programmes through Entrustable Professional Activities are in progress.

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Word Count: 1759

BACKGROUND

Competency-based educational models are commonplace in undergraduate medical education.[1] However, the need to be 'signed off' at individual tasks without consideration of capability could result in medical graduates who are unprepared for the complexity of clinical work.[2,3] Developing capability refers to the ability to integrate multiple technical and non-technical competencies and skills in challenging, ever changing and unfamiliar environments.[4] Clinicians demonstrating capability successfully adapt their knowledge and skills to scenarios, maintaining professionalism and knowing their limits. British governing bodies have shifted away from 'competence' to 'capability' in outcomes for newly qualified doctors. The General Medical Council's (GMC) most recent 'Outcomes for Graduates' guideline emphasises dealing with complexity and uncertainty, with the increasing demands on healthcare professionals.[5,6] Therefore, it is imperative that medical schools go beyond teaching competency and ensure capability through training and assessment.

"Clinicians demonstrating capability successfully adapt their knowledge and skills to scenarios, maintaining professionalism and knowing their limits"

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Cannulation is a common medical procedure undertaken by medical and allied health professionals. Undergraduate clinical skills training commonly involves teaching appropriate
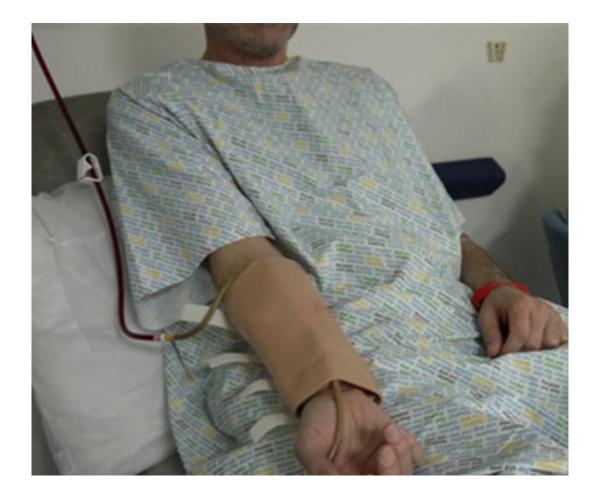
technical procedural steps, followed by the ability to practice on simulated part task trainers and then clinical practice on patients. Many studies have highlighted the importance of Human factors and non-technical skills for crisis resource management and teamwork but there is limited published research evaluating training on relevant Human Factors and non-technical elements of common procedural skills such as cannulation for newly graduated doctors. This project explored the perceived impacts of a cannulation-based e-learning and high fidelity simulation course on final year medical students' capability and preparedness for practice for intravenous cannulation.

APPROACH

An e-learning module based on intravenous cannulation was developed through a collaboration between University of Plymouth and Becton Dickinson, to address high cannula complication and failure rates.[7] The needs assessment was led by two highly experienced, master's level clinical educators, based on their experience of teaching skills such as cannulation. The resource is aimed at medical professionals such as doctors, nurses, paramedics and allied health professionals. The e-learning comprised four modules; 'Prepare', 'Procedure', 'Preserve' and 'Communication Skills and Human Factors'. A combination of referenced theory, interactive quizzes, and demonstrative videos were utilised to deliver an in-depth, engaging experience.

Box 1. E-learning - Underpinning Educational Theory:

- Observational learning: Demonstrative videos of cannulation and application of human factors
- Connectivism: Utilising technology to promote effective learning
- Multimedia learning: Using combined formats of audio, text and visual in the design
- Segmenting: Breaking up a complicated topic into distinct sections
- Learner control: Giving the student control of the pace of learning
- Personalisation: Presenting text in an informal style
- Signalling: Using visual cues to highlight key learning points in the narration

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Ten final-year medical students were recruited via convenience sampling methods (5 female, 5 male). The cannulation course consisted of an initial high-fidelity simulation, followed by the e-learning package, and then a second simulation to finish. A hybrid simulation model was used, featuring a Simulated Patient (SP) with a bespoke intravenous cannulation part-task trainer strapped to their arm. A student nurse played the role of a nurse in each scenario, available to assist the participant if prompted. The simulation was set in a non-standardised challenging hospital-based scenario, which is described in detail below. The first set of simulations were held two weeks before the second, allowing ample time for participants to engage with the e-learning, which was mandatory for progression. An example vignette is given below:

You are the foundation doctor covering the medical wards overnight. The nurse has asked you to cannulate John Wheeler whose previous cannula became infected and had to be removed. The patient requires their next dose of antibiotics for pneumonia. It is 10pm and the patient is asleep. Please perform cannulation as an F1 (Foundation Year One) doctor would.

The scenario required students to deal with many issues that they may not have encountered before, which are commonplace in clinical practice. The SP was instructed to be drowsy, then irritable and adopt an awkward position. The SP highlighted concerns around the sterility of the procedure, pressing the participant to explain the procedure and reassure them. There were environmental challenges such as poor lighting and lack of sterile wipes which only the nurse had access to, compounding the need to engage with the team or risk further confrontation with the SP. The design of these hybrid simulations embedded the requirement for capability through the need to integrate multiple competencies, non-technical skills, and personal qualities in an unfamiliar and challenging environment.

"The scenario required students to deal with many issues that they may not have encountered before"

"The design of these hybrid simulations embedded the requirement for capability"

Qualitative methods were chosen to explore 'why' aspects of the course worked and understand this in relation to capability. Simulations were video-recorded and reviewed and reflected on by participants prior to semi-structured interviews. The interviews acted as a reflexive debrief for students, however, there was no formal debriefing session. Trained facilitators were available throughout the course for individual debrief, although these were not evaluated. Questions were written by two clinical academics, who designed the capability concept model, to explore the development of capability across all elements of the simulation process.

The primary researcher (intercalating masters student) transcribed the audio-recorded interviews verbatim, including pauses and filler words. The primary researcher used NVivo software to carry out inductive thematic analysis on the data, which allowed the quotes to guide the analysis.[8] Quotes were initially saved under various 'nodes', which later developed into themes after discussions within the research team.

Box 2. Semi-Structured Interview Questions:

- What aspects of the e-learning did you find most valuable? Why?
- Was there any difference in your overall approach to cannulation in each of the simulations?
- How did you feel in each scenario? Was there any difference?
- What aspects do you feel the training has helped with?
- As a result of this experience, are there any changes that you will make when performing cannulation in the clinical environment?
- In August you will be a foundation doctor. How do you feel the training has helped to prepare you to perform cannulation as an independent practitioner?
- If you were going into another unknown situation like the first simulation, how would you tackle it?

Ethical approval was granted by University of Plymouth Faculty of Health & Human Sciences, Schools of Medicine and Dentistry Research Ethics Committee (ref. 17/18-343). Informed consent was gained and participant confidentiality maintained.

EVALUATION

Impact on Capability

After completing both simulations, participants reported that the learning experience provided a more holistic approach. During the first simulation, they acted in a task-focused manner – aiming only to get the cannula in successfully. The unfamiliarity of the scenario and challenges with communication, equipment and ergonomics distracted participants from the task. This led to poorer performance as they were unable to integrate competencies and non-technical skills effectively.

> #3 '*In the first scenario… I was going into an unfamiliar area… set up in a way that I didn't recognize… that meant I wasn't 100% focused on the task of putting in a cannula… with all of these other things going on as well*'

In the second scenario, their task-orientated focus shifted away from the primary goal to include other elements such as the patient interaction, interprofessional working, and recognizing limitations. The participants felt that their capability improved in the second scenario following their initial experience and the e-learning.

> #2 *'(I was) able to use more of my brain power focusing on the actual interaction with the patient instead of worrying about what to pick up and how to put a cannula in'*

Participants demonstrated their ability to adapt knowledge and skills to the scenario, particularly after engagement with the e-learning which helped them to structure the procedure and adapt to obstacles. The simulations gave participants confidence that they could manage challenging intravenous cannulation in real-world practice, as they have practiced the basic competencies and non-technical skills together.

"Participants demonstrated their ability to adapt knowledge and skills to the scenario, particularly after engagement with the e-learning"

"The simulations gave participants confidence that they could manage challenging intravenous cannulation in real-world practice"

> #4 *'I think I would feel a lot better with tackling it (an unfamiliar scenario) because that's kind of given me the confidence that although it was different, I could still use the skills that I already knew to apply it to that situation'*

Preparedness for Practice

Training was seen as competency and task-based, with formulaic interaction with patients only. Participants recognized that this does not reflect clinical practice and that other elements may be more challenging than the cannulation task itself. They felt that the training and experience from this study helped them to feel more prepared for the challenges of practice.

> *#6 'The practice we get in medical school is very basic… it is purely getting the job done, it's not really interacting with the patient. But obviously that at times would be harder than the cannulation itself, to… get the patient on your side and… make sure they have a positive experience from it… That's where… having this sort of training prepares you for real-life scenarios where it's not always easy just to get a cannula in'*

There was evidence of improved preparedness for practice in dealing with challenging cannulation. Some participants felt that simulations had the largest impact on preparedness. Others felt the e-learning gave them confidence that they are performing to a high standard, reducing uncertainty.

> *#4 'I just feel more prepared from having the practice'*

> *#3 'Before this, I don't think I had such an in-depth teaching session that the e-learning provided… I certainly feel more confident now, knowing that what I am doing is the correct procedure'*

> *#10 'It has helped prepare me more for the job of cannulation when I'm an F1'*

IMPLICATIONS

This project was successful in delivering a comprehensive course to medical students on intravenous cannulation. The interviews demonstrated development of learners' capability

and preparedness for practice. Participants became more patient-focused and demonstrated their ability to integrate multiple competencies with their non-technical and personal skills, a pivotal part of the capability model.[8] Students had improved self-efficacy[9] with an ability to control, adapt and improvise in practice following both interventions, suggesting enhanced capability.[8,10,11] E-learning gave participants a framework to use to perform the procedure which could then be adapted. The module has been translated into 12 languages and is available from Becton Dickinson. Hybrid simulations offered realistic practice, giving participants the confidence to adapt to various challenging scenarios. Formal debriefing following simulation was not undertaken as part of this course but would likely add value to the course.

> *"Participants became more patient-focused and demonstrated their ability to integrate multiple competencies with their non-technical and personal skills"*

UK medical training often follows on a competency-based curriculum, where minimum standards are met in sets of knowledge and skills. This does not reflect the real-world environment where elements surrounding the task often present more challenge than the technical skill.[11] This highlights a need for training in capability at undergraduate level, as supported by the GMC who discuss capabilities - as opposed to competencies - and the need to manage complexity.[5,6] New medical graduates in the UK are known to feel a lack of preparedness for complex situations,[12] exacerbated by a rapidly evolving healthcare system.[13] Self-efficacy and confidence are known to reduce stress and increase performance in the phase between student and doctor.[14]

"…(competency-based undergraduate curriculum) does not reflect the real-world environment where elements surrounding the task often present more challenge"

At the Peninsula Medical School, local skills training in the clinical environment involves specific details regarding supervision and a requirement to follow local hospital protocols. Workplace based assessments (WPBAs) utilise holistic judgements and domain based scoring rather than checklists which are more appropriate for assessment during novice stages of training. We are planning to develop our WPBAs further to incorporate Entrustable Professional Activities (EPAs) for the assessment of key job related activities which graduates are expected to perform as Foundation doctors. EPAs allow experts to judge the capability of the learner for key clinical activities and the level of supervision the assessor trusts the individual to require to safely carry out these tasks, and could be just as useful across the healthcare professions.[15] Incorporating the concept of 'Training for capability' into the curricula of Health Professions Education programmes with responsibility for training procedural skills is important for high standards of patient safety.

AUTHOR CONTRIBUTIONS

Harry Carter: Methodology, Data curation, Investigation, Validation, Formal analysis, Project administration, Resources, Writing - original draft, Writing - review & editing, Conceptualization, Software. **Sally Hanks:** Conceptualization, Methodology, Data curation , Validation, Formal analysis, Supervision, Resources, Writing - review & editing. **Robert Johnson:** Conceptualization, Writing – review & editing, Software, Resources, Methodology, Visualization. **Thomas Gale:** Conceptualization, Methodology, Software,

Data curation , Validation, Formal analysis, Supervision, Funding acquisition, Resources, Writing - review & editing.

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CONFLICT OF INTEREST STATEMENT

ETHICAL APPROVAL

The University of Plymouth Faculty of Health & Human Sciences, Schools of Medicine and Dentistry Research Ethics Committee granted ethical approval for this project (ref. 17/18-343).

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BOXES AND FIGURES

Box 1: E-learning - Underpinning Educational Theory

Box 2: Semi-Structured Interview Questions

Figure 1: Hybrid simulation design

Figure 2: Simulation in progress