SHORT REPORT

Making reasoning visible through process mapping in digitally simulated clinical reasoning assessments

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Abstract

Introduction: Making the processes underpinning students' approaches to given tasks visible is challenging. The aim of this study was to assess the viability of microanalysis of a digitally simulated clinical reasoning assessment.

Methods: Eighty-five second-year optometry students were invited to participate in recall interviews. Through thematic analysis, we constructed a codebook and through microanalysis, process maps were created.

Results: The codebook had four themes and 27 codes. The 53 process maps were synthesised to demonstrate decision making.

Conclusion: Microanalysis could be used in future studies to explore underlying cognitive processes in digitally simulated clinical reasoning assessment in optometry education.

Keywords: clinical reasoning; health professional education; optometry education; simulation-based education; assessment

Introduction

Research into clinical reasoning has a long and storied tale embracing the very nature of it, assessing health professional students' capacity to practise and/or learn clinical reasoning (Barrows & Feltovich, 1987). In optometry education, there is a growing body of evidence exploring how optometrists and optometry students develop the clinical reasoning process (Edgar, Ainge, et al., 2022; Edgar, Macfarlane, et al., 2022). Randomised controlled trials from the nursing education literature confirm that simulation is a more effective teaching strategy for developing clinical judgement than traditional teaching (Yang et al., 2019). In addition, a wide array of assessment methods

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and instruments designed to assess clinical reasoning exist in health professional education (Daniel et al., 2019). Notwithstanding this, understanding how students approach clinical reasoning tasks, including assessment frameworks, is challenging (Cooper et al., 2021), and there is ongoing debate about how to teach and assess clinical reasoning.

Many assessment methods focus on obvious elements of clinical reasoning, such as information gathering, generating differential diagnoses and developing targeted management plans (Daniel et al., 2019). In their exploration of the diagnosis and management of clinical reasoning difficulties, Audetat and colleagues (2017) argue there should be a focus on the reasoning processes. These are not just the judgments that are made but the hidden metacognitive processes that underpin the final decision. Another challenge lies in making visible to both assessors and trainees the nuanced aspects of clinical reasoning included in the reasoning process. Therefore, we designed this study to understand the less discernible elements of clinical reasoning, including the metacognitive steps that underpin the reasoning process.

Microanalysis has been used to make visible the underlying processes that students apply in activities, from creative processes to medical education (Callan et al., 2021; Smith & Corrigan, 2018). Process mapping, a form of microanalysis, has been successful in capturing the decision making of students in problem-based learning (Smith & Corrigan, 2018). Therefore, we hypothesised this method of data collection could be applied to unveil the decisions students make during clinical reasoning assessments. The purpose of this feasibility study is to determine whether process mapping can provide insight into the clinical reasoning processes of students when completing a digitally simulated clinical reasoning assessment in optometry education. The research seeks to answer the following question: "Can the method of process mapping unveil the decisions optometry students make during a digitally simulated clinical reasoning assessment?" This research could lay the groundwork that contributes to broader methodological frameworks and educational research into the intricacies involved in teaching clinical reasoning.

Methods

The qualitative study was conducted within the optometry program in the School of Medicine at Deakin University, Australia, in July 2022. There are on average 85 students enrolled in the second-year cohort of this 10-trimester program, which is conducted over consecutive trimesters to enable completion of a 5-year program in a 3.5-year course. Participants are defined as students from the second-year cohort of the optometry program, and "student researchers" are defined as students from the third-year cohort. A convenience sampling method was used to recruit participants from a cohort of second-year students who were completing the assessment in this study as part of the regular learning activities within the curriculum. The convenience sampling was based on interested second-year students who made contact with the student research group after seeing advertisements on university noticeboards. Student researchers were third-year students in their final year of the curriculum. They were completing a research unit and, thereby, had a knowledge base and the research training to conduct semi-structured interviews; they were specifically trained for process mapping interviews by GC & SE. Approval from the Deakin University Human Research Ethics Committee (HEAG-H 33_2022) was obtained for this study. A plain language statement and informed consent forms were provided prior to participation.

Data collection

This feasibility study consisted of structured stimulated recall interviews after participants completed a digitally simulated authentic clinical reasoning assessment. The assessment replicated the complexities of a clinical case presentation in an optometry practice. It was designed to develop clinical reasoning by compelling students to make decisions at time points similar to an optometric consultation, i.e., differential diagnosis, gathering information, examination, diagnosis and management. The assessment occurs on three occasions during the second year of the curriculum. Participants of this study had previous experience completing the assessment in a prior teaching period in the same format as was used in this study. Participants were provided a proforma to complete during the digitally simulated clinical reasoning assessment, which collected their decisions during the assessment. Information collected was used in the next stage of data collection, structured stimulated recall interviews.

Structured stimulated recall interviews incorporated open-ended questions to guide the discussion regarding the decisions that participants made. Using participants' responses to open-ended questions, interviewers drilled down to uncover the underlying processes that were used to make decisions until saturation was achieved. At each decision point, participants were asked if their decision in the digitally simulated clinical reasoning assessment was conscious or unconscious. The interviews were held online, using a virtual meeting platform, directly after completion of the assessment to reduce the effects of recall bias. The participants were not provided with the correct answers for the assessment prior to participating in the interview. Interviewers, student researchers trained by GC & SE, performed the audio-recorded interviews and reviewed the transcription before analysis was performed. The interviews were conducted by a pair of student researchers to ensure validity and consistency of the data collection process.

Construction of process maps

The responses from interviews were categorised based on a codebook generated through an inductive thematic analysis. AE, LC & LA drafted codes, using 10% of the transcripts, before meeting to review and map codes to thematic domains to develop a draft set of themes. AE, LC & LA independently analysed all remaining data using the coding structure, with constant comparison to identify new concepts. GC, SE, LC, AE & LA reviewed the relationships between categories and discrepancies that arose until consensus was reached and a codebook was created. JA independently reviewed the codebook used for process-mapping analysis.

GC, SE, LC & AE independently generated process maps using the codebook and the process outlined by Smith & Corrigan (2018). Process maps were constructed by researchers in chronological order, in line with what was directly said by participants in the interview. GC, SE, LC & AE met to review all process maps to come to a consensus regarding one overarching process map for each participant that represented the conscious decisions they made through the assessment. The codebook was reviewed to refine any discrepancies. Subsequently, GC, SE, LC, AE & JA met to agree to the structure and content of the process maps, and consensus about categories in the codebook was reached.

Results

A codebook was generated, see Appendix A, including 4 themes and 27 codes. Using the codebook, 53 process maps were generated based on the interviews of three participants who completed the digitally simulated clinical reasoning assessment. This was followed by a structured recall interview. Microanalysis produced a total of 17 process maps for participant 1 and 18 for participants 2 and 3. For each participant, one overarching map was produced, compiled from all process maps for that participant (see Figure 1). The resultant process maps and codebook enable the microanalysis of decisions within the assessment. This analysis, at the level of an independent student learner, makes discernible or less discernible elements of decision making visible.

Discernible elements of clinical reasoning

The process maps illuminated discernible elements of clinical reasoning, such as deciding on a particular differential diagnosis, e.g., "She said that she had redness, so I just started thinking about differentials with redness", or selecting a particular test to perform, e.g., "the Seidel test to show any leaks from the cornea".

Less discernible elements of clinical reasoning

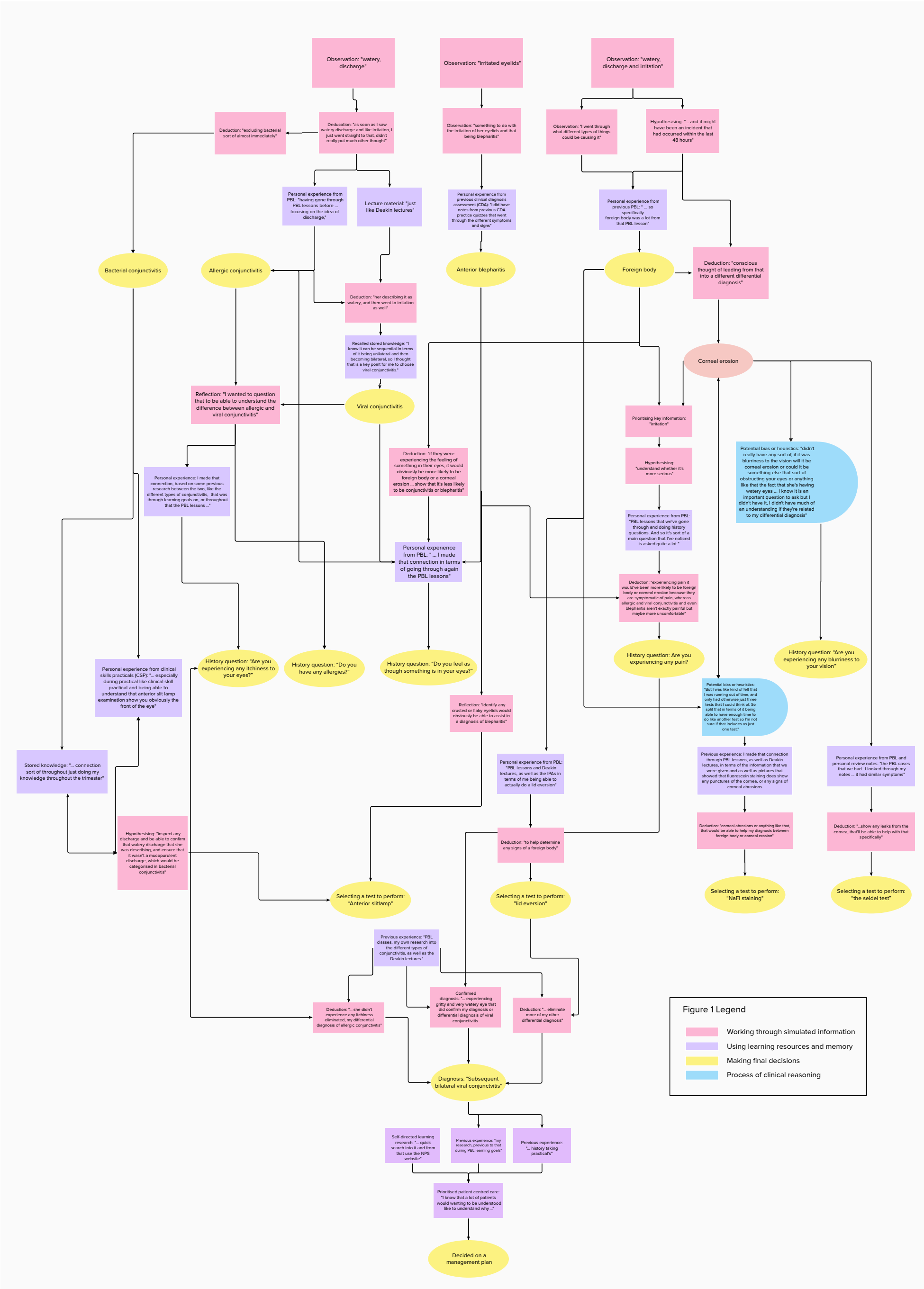
The process maps also allowed for the less discernible elements of clinical reasoning to be more visible, such as the impact of prioritising patient centred care, e.g., "I know a lot of patients would be wanting to be understood", or their personal lived experience, e.g., "like even me when I get allergies, I get red eyes", and potential biases, such as premature closure, e.g., "I went straight to it being either allergic or viral. And so didn't really put much extra thought beyond it being [bacterial] conjunctivitis".

Discussion

In health professional education, the development of clinical reasoning is a well-known competency standard, and there is a requirement for the skill to be taught and assessed (Daniel et al., 2019). Simulation is one accepted method for teaching clinical reasoning (Edgar, Macfarlane, et al., 2022; Yang et al., 2019). The field is, however, diverse,

Figure 1

Illustrative Example of a Process Map



Note: Shows the categorised decisions of one participant based on thematic analysis using the developed codebook and a large number of assessment methods proposed across different professions can make it difficult to select appropriate teaching and assessment activities (Cooper et al., 2021; Daniel et al., 2019). In addition, clinical reasoning involves both conscious and unconscious processes to be performed by the trainee, and these metacognitive processes are rarely apparent to the assessor (or trainee). This study demonstrated that the clinical reasoning processes that optometry students employ at an individual level in a digitally simulated authentic clinical reasoning assessment can be revealed using a microanalytic method called process mapping. The process maps demonstrated obvious stages of clinical reasoning, such as confirming a diagnosis, as well as analytical and heuristic processes, such as reflecting on personal lived experiences that contributed to these outcomes (Figure 1).

Process mapping extracts the conscious decision making in which students engage and the reason for these decisions. The product of this process, a process map, provides insight into why students make the decisions they do. This is important because all decisions are subject to errors or biases, and there is a need for research approaches that can identify strategies to mitigate these within optometric practice (Shlonsky et al., 2019). Process mapping reveals the nuanced aspects of clinical reasoning, such as differentiating between heuristics and biases at the level of an independent student learner. Future research using process mapping with a larger sample has the potential to uncover the different strategies students use when approaching clinical reasoning tasks and the variables, such as biases and heuristics, that may influence outcomes across a cohort. In addition, by visually portraying how a learner navigates through a clinical reasoning task, process mapping could be used to provide feedback that assists cognitive and metacognitive development.

We appreciate that the analysis of process maps for three participants does not produce a comprehensive description of strategies taken by the cohort. However, the methodology produced a large data set and detailed insights into individual students' decision-making process during a digitally simulated authentic clinical reasoning assessment. As this serves as a feasibility study, given the extensive data generated during micro-analysis, a smaller sample is reasonable for the initial development of a codebook and process-mapping process. This limitation in sample size prohibits the generalisation or further analysis into these findings, however the codebook generated in this study can be used in future iterations of microanalysis with process mapping and clinical reasoning within the context of optometry. This feasibility study found process mapping unveiled the decisions optometry students make during a digitally simulated clinical reasoning assessment, and the research lays the groundwork to contribute to broader methodological frameworks and educational research into the intricacies involved in teaching clinical reasoning.

This research continues to evolve using an approach inspired by grounded theory to understand how optometry students' clinical reasoning is shaped using digitally simulated clinical reasoning assessments. Future investigations will explore how optometry students compare to qualified optometrists and how process mapping can be used as a feedback method to inform future assessments and clinical experiences. The scope of this methodology may not be limited to developing clinical reasoning or assessment and could extend to the development of other professional skills and professional identity.

Conclusion

The initial microanalysis demonstrated that students are utilising clinical reasoning to make conscious decisions and that process mapping has potential to investigate the underlying process further. We identified that heuristics and biases were present in the cognitive process students used to make decisions in the simulated clinical case. Future work can focus on uncovering whether these biases are induced by developed cognitive processes or by the assessment task itself, which compels the student to make a decision that aligns to the pre-developed framework. In addition, process mapping could serve as a method to understand the influence these biases have on errors in clinical reasoning. Furthermore, microanalysis requires concentrated human resources at present. With the rapid advances in large language models, this could develop into a more efficient process, with increased suitability for large scale use.

Conflicts of interest and funding

The authors declare no conflicts of interest, and no external funding was associated with this project.

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Appendix A

Resultant Codebook Generated From Inductive Thematic Analysis

Code	Sub Code	Description
Working through the simulated information provided	*"Prioritising perceived key information"*	The participant decides selected information is most important in the clinical case.
	Observation	The participant made an observation.
	"Reflection (alternative)"	The participant decides to consider what their next steps should be to support their clinical reasoning to work towards formulating a decision.
	Deduction	The participant decides to make a deduction (based on their cognition of the clinical case).
	Infer	The participant decides to deduce or conclude from observations.
	Hypothesising	The participant decides to hypothesise.
	"Prioritised patient-centred care"	The participant took into consideration the needs of the patient.
Using learning resources and memory	*Structured memory*	The participant draws on structured memory to apply to the scenario.
	"Recall of stored knowledge"	"The participant draws on remembered knowledge to apply to the scenario."
	Personal lived experience	The participant draws on experience from their personal life to apply to the case.
	"Utilising personal review notes"	"The participant uses their personal notes and applies these to the scenario."

Code	Sub Code	Description
Using learning resources and memory *(continued)*	*"Self-directed learning: Research"*	The participant applies knowledge gained from research from an unspecified source.
	"Self-directed learning: Research from journal articles"	The participant applies knowledge gained from researching academic journals.
	Lecture material	The participant applies knowledge gained from lectures.
	"Self-directed learning: Research from learning goals"	"The participant applies knowledge gained from researching team devised questions, known as learning goals, in problem-based learning."
	"Personal experience from problem-based learning"	The participant draws on learnings from participating in problem-based learning.
	Personal experience from previous clinical diagnosis assessment	The participant uses knowledge gained from previous clinical diagnosis assessment scenarios.
	"Personal experience from clinical skills practicals"	The participant uses knowledge gained from clinical skill practical sessions.
	Personal experience from individual procedural assessments	The participant uses knowledge gained from performing clinical skills in an assessed environment.
	"Metacognition of learning"	"The participant reflecting on or awareness of their learning process."
Making final decisions	*Decide on a particular differential*	The participant decides on a specific differential diagnosis.
	History question	The participant decides to ask a specific history question.
	Selecting tests to perform	The participant decides to order a specific test.
	Diagnosis	The participant decides to make a specific diagnosis.
	Explicit management decisions	The participant decides to provide specific management advice.
Process of clinical reasoning	*Potential bias or heuristic*	Decision made without clear explicit reasoning (inc. time constraint).
	Thinking about clinical reasoning	The participant reflects on their awareness of the clinical reasoning processes and/or complex nature of clinical reasoning.