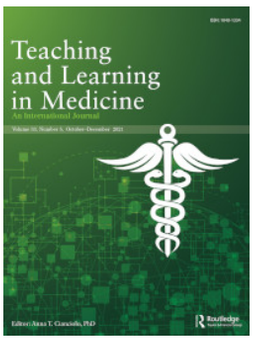

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GROUNDWORK

What Were You Thinking? Medical Students' Metacognition and Perceptions of Self-Regulated Learning

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ABSTRACT

Phenomenon: As a component of self-regulated learning, metacognition is gaining attention in the medical education research community. Metacognition, simply put, is thinking about one's thinking. Having a metacognitive habit of mind is essential for healthcare professionals. This study identified the metacognitive competencies of medical students as they completed a conceptual learning task, and provided insight into students' perceptions of self-regulated learning in their curriculum. *Approach:* Eleven third-year medical students from a Dutch University were purposively sampled to participate in this qualitative study. The study design included a think-aloud assignment followed by a semi-structured interview. During the assignment, participants were instructed to think aloud while solving questions about medical physiological concepts such as blood flow, pressure, and resistance. Think-aloud data were collected through audiotaping and used to identify participants' metacognitive competencies. The assignment also served as a prompt for an interview in which participants were questioned about metacognitive knowledge, monitoring, experiences, and perceptions of self-regulated learning in their curriculum. All data were transcribed verbatim and analyzed iteratively using a template analysis. *Findings:* Students differed in their use of metacognitive skills, with an overall focus on monitoring and, to a lesser extent, on planning and evaluation. Additionally, differences were found in students' metacognitive knowledge and metacognitive experiences. There was apparent use of inefficient, superficial predictive cues. Regarding perceptions of self-regulated learning skills, some students felt no need to develop such skills as they perceived medical education as an exercise in memorizing facts. Others emphasized the need for more insight into their actual level of knowledge and competence. *Insights:* Pre-clinical medical students require explicit teaching of metacognitive skills to facilitate self-regulated learning. Educators should aim to integrate metacognition in the everyday discourse of the classroom to foster an environment in which students discuss their own learning.

KEYWORDS
Metacognition; self-regulated learning; medical students; qualitative research

Introduction

Self-regulated learning is a necessary skill for healthcare professionals to develop.[1] However, medical students often struggle to acquire the level of metacognition required for self-regulation.[2,3] Although there is ample literature on self-regulated learning in medical education, studies identifying which metacognitive competencies are underdeveloped in medical students remain scarce. Possessing adequate metacognitive competencies is particularly valuable for final year pre-clinical students who are about to enter the clinical environment. In this study, we therefore investigated final year pre-clinical students' metacognitive competencies and their associated perceptions of self-regulated learning.

Self-regulated learning is a cyclical process during which a learner plans one's activities prior to a task, monitors these activities during a task, and evaluates the outcome after a task.[4] Self-regulation is recognized by the medical education community as an important prerequisite for effective learning. It is a common

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incorrect assumption, however, that this skill is implicitly acquired.[5] Development of self-regulation is a shared responsibility between both students and educators and therefore needs to be addressed in medical training.[1,6]

Sophisticated self-regulated learners are capable of reflecting on their own performance and modifying their approach for future attempts.[7,8] In essence, self-regulated learners are the captains of their own learning. David Sackett pleads for more captains by advising:

> Half of what you'll learn in medical school will be shown to be either dead wrong or out of date within five years of your graduation; the trouble is that nobody can tell you which half—so the most important thing to learn is how to learn on your own. (p. 1431)[9]

Multiple studies have reported benefits associated with adequate self-regulated learning, including enhanced academic achievement, safer and more effective practice, and obtainment of a lifelong learning attitude.[10–12] Self-regulated learning can thus be considered necessary to all practicing healthcare professionals who have a societal obligation to continuously develop their knowledge.

The cycle of self-regulated learning is guided by three interrelated components: cognition, metacognition, and motivation.[13] While most medical education studies focus on cognition[14] and motivation,[15] research on metacognition is relatively limited. In the social-cognitive sciences, researchers have been studying metacognition for several decades. Flavell and others have described three major components of metacognition, which may facilitate metacognitive teaching practices in the classroom.[16–19] Firstly, one may explicitly teach students about *metacognitive knowledge*; for example, educators should help students to become aware of their strengths and weaknesses regarding learning, and of what they know and do not yet know. Secondly, one may explicitly teach *metacognitive skills*; for example, educators should provide students with effective strategies for learning so students can use them when studying. Thirdly, one may explicitly teach students about *metacognitive experiences*; for example, students' feelings related to the learning task such as a feeling of puzzlement or an aha-experience. Metacognitive experiences are often used by learners as heuristic superficial cues which form the basis for their judgements of learning.[2,20] For instance, medical students may judge their chances of making the right diagnosis based on the speed with which this diagnosis came to mind. However, fast thinking does not necessarily mean that the student's response is correct. Rather, comprehension-based cues that are formed by causal reasoning are more predictive of correct responses.[21]

The development of metacognitive competencies already should play an important role at the start of medical training; possessing these competencies can be particularly valuable when final year pre-clinical students transition to clinical learning. The transition from being a pre-clinical student in school to a clinical student in the workplace is quite demanding, and students must adapt to a more self-regulated learning style.[22] Although it is known that medical students often struggle to acquire an adequate level of metacognition,[2,3] limited studies have investigated the metacognitive knowledge, skills, and experiences that final year pre-clinical students have (not yet) acquired to be able to regulate their learning.

In this study, we used a qualitative approach to investigate final year pre-clinical medical students' task-specific metacognitive knowledge, skills, and experiences. Additionally, we identified students' perceptions of self-regulated learning in the undergraduate medical curriculum to relate our findings on task-specific metacognitive competencies to the broader self-regulated learning context. The research question of this study was: What type of metacognitive competencies do final year pre-clinical medical students display, and how do they perceive these competencies and self-regulated learning in the curricular context? Research on metacognitive competencies in final year pre-clinical students and their perceptions of self-regulated learning will provide insight in potential difficulties and barriers regarding the development of metacognition and self-regulated learning. Consequently, findings may help educators to design effective teaching programs for acquiring metacognitive competencies and self-regulated learning.

Methods

Context

This study was conducted at Leiden University Medical Center (LUMC), the Netherlands. The LUMC offers a six-year medical training program; undergraduate Years 1–3 are pre-clinical and graduate Years 4–6 consist of clinical clerkships. The Framework for Undergraduate Medical Education in the Netherlands describes the learning outcomes that medical students should achieve in their training to effectively meet the standards of health care. One of the learning outcomes is that undergraduates should possess metacognitive competencies that are necessary to handle a high level of

autonomy.[23] However, in the current LUMC curriculum, formal teaching of such skills is limited.

The curriculum is based on the CanMEDS competency model, with an emphasis on the medical expert in the first three years. Throughout the curriculum, students participate in large-group lectures complemented by small-group learning activities in which they work on case-based assignments. Development of self-regulated learning is formalized in the curriculum through "teacher–coach conversations," which encompass eight group sessions and two individual sessions per year. During these conversations, the teacher–coach is supposed to discuss, support, and stimulate study progress, motivation, and personal development for the CanMEDS competencies. All competencies are graded, including communication, professional behavior, and physical examination. Grading is occasionally followed by narrative feedback from a teacher, but this does not necessarily have to be the same teacher as the teacher–coach. This study was conducted during the third year of the pre-clinical phase. We used this specific population of final year pre-clinical students as they are expected to have sufficient metacognitive competencies in order to be successful in their clerkships that start after this year.

Participants

During January–April 2019, the first author (MV) approached final year pre-clinical students by e-mail. These students had participated in a previous study on peer instruction and metacognition in their first year of medical school.[24] Participants were purposively sampled based on their metacognitive performance in Year 1, which was assessed quantitatively.[25] Using this approach allowed us to obtain a sample of participants with varying levels of metacognitive competencies. Additionally, we aimed for gender variation representative of the medical student population in the Netherlands (30% male, 70% female). In total, 30 students were approached to participate in this study, and 11 students eventually participated. Reasons for not participating mainly included a lack of time for example due to exam periods. To preserve anonymity, we cannot include more potentially identifying information about the participants. Students gave verbal consent to audio-recording before the session and signed an informed consent form afterwards. They were given a free lunch worth €7.50 in compensation for their effort. This study was approved by the Institutional Educational Research Review Board of the LUMC, reference number: OEC/ERRB/20181009/1.

Data collection

Data were collected through a combination of two qualitative methods. First, we conducted a think-aloud procedure to identify students metacognitive skills and metacognitive experiences. This procedure was followed by a semi-structured interview to gain insight in students' metacognitive knowledge and perceptions of self-regulated learning in the undergraduate medical curriculum. The think-aloud session also informed the questions that were asked during the interview to connect the findings on metacognitive competencies, as a subcomponent of self-regulated learning, to students' perceptions on self-regulated learning. The first author (MV) was present during the think-aloud sessions and conducted the interviews afterwards.

The think-aloud assignment and interviews were audio-recorded and transcribed verbatim by the first author (MV). At the start of the assignment, participants were asked to think aloud while solving four exercises on medical physiology. These exercises were designed by an expert physiologist (PS) and aimed to activate participants' scientific reasoning and conceptual thinking. The questions were posed in a two-tier multiple-choice format and focused on the interrelated concepts of blood flow, resistance, and pressure (see Appendix A in Supplementary Material for an example). Factual knowledge was presented on an information sheet, so students mainly had to focus on application and integration of the information. After each exercise, students were prompted to evaluate their conclusions by asking how sure they were of their provided answer. If participants were silent for more than three seconds, they were asked to continue to think aloud. Prior to the physiology questions, participants received two questions to practice thinking aloud.

The think-aloud procedure was also used as a prompt for the subsequent semi-structured interview. For example, participants were asked how they had experienced the learning task, whether the questions were difficult, and how they would try to solve them. The interview guide was developed by MV, GB, MW, and BO (see Appendix B in Supplementary Material). The interview guide was designed and structured based on theoretical concepts of metacognition.[4,17–19,26] This guide included questions about goal-setting, learning strategies, and reflective activities. Other issues that were pursued during the interview concerned participants' perceptions of self-regulated learning in the medical curriculum. These questions focused on the value of knowing what one does (not) know and how learning activities could enhance this. Each session, consisting of a think-aloud procedure

and interview, lasted on average 45 minutes. Theoretical saturation of the themes was reached after eight interviews, meaning no additional data were found to develop new themes. Subsequently, we conducted three last interviews to check saturation, which is common practice in qualitative health research.[27]

Data analysis

Data analysis and collection proceeded in an iterative fashion. The data were coded, analyzed, and interpreted by MV, GB, and MW using template analysis[28] based on metacognitive theory,[19,26] allowing *a priori* themes to be used in developing the initial version of a coding template. These *a priori* themes were: metacognitive knowledge (i.e. of self, of task, of strategy), metacognitive skills (i.e. planning, monitoring, and evaluating), and metacognitive experiences. MV and GB performed preliminary coding on Transcripts 1–3 independently to create an initial template. The codes were cross-checked until consensus was reached between the researchers about the coding, codes, and template. As the number of interviews grew, we kept refining the coding template. The coding template was compared and discussed by MV and GB throughout the data collection period. MV used the template to code Transcripts 4–5, and Transcript 6 was independently coded by GB. Further refinement of the template through collaborative analysis among the research team led to template consensus (see Appendix C in Supplementary Material). This final template was use by MV to code the remaining transcripts (7–11).

Reflexivity

The team consisted of researchers with varied backgrounds and expertise in qualitative research to facilitate interpretation of our findings using multiple perspectives. The first author (MV) holds a doctorate degree in medical education with a background in neurobiology and has a particular interest in metacognition and conceptual thinking. All other authors are active in the field of medical education research and have different backgrounds, including medical anthropology and sociology (GB), pedagogical sciences (BO), educational sciences (MW), medicine (AdB), and physics (PS).

Results

We identified the metacognitive skills that students displayed during problem-solving. With our template we were able to identify whether difficulties occurred for specific subtypes of metacognitive skills.

Planning

Planning occurs prior to the problem-solving process and includes setting goals, selecting appropriate strategies, making predictions, sequencing strategies, and allocating resources.[26] All these themes were found in this study. During the think-aloud assignment, some students demonstrated planning behavior by creating an overview of the important characteristics of the exercise, either by highlighting, summarizing, or visualizing. In the interview, students would often recognize their ability to create overview.

> Well, I think I am good at creating an overview. I will not start problem solving before creating an overview. Generally, I write down all the information and highlight the important information to clarify things before I start problem-solving. (P9).

Further, some students specified that their strategy was to first identify the problem (i.e. setting the goal), before doing anything else. However, this was rarely done explicitly during the think-aloud assignment.

> Usually, I read the questions first and quickly after that I move on to what is really been asked from me, before reading all the text. However, I did not really do it now [during the exercise]. (P3).

Generally, little time was devoted to planning prior to problem-solving. Several students spent some time identifying the problem and allocating resources that were needed to solve the question, however there were also students who missed out on information to solve the question because they did not accurately record which information they had at their disposal.

Monitoring

Monitoring is the online awareness of comprehension and performance and thus takes place during actual problem-solving.[26] Students used various forms of monitoring, that is, strategies, during the think-aloud assignment. Regularly used strategies included rereading, goal-checking, visualizing the situation, and eliminating answer options to get to the correct solution. Students rarely switched between different strategies. Generally, they started to use a different approach only when their initial outcome did not align with one of the answer options. Some students admitted that they did not consciously use specific metacognitive strategies during the think-aloud assignment. A large variety in awareness of student's strategy use was found.

> I do not really have specific strategies, that I think wow, I should do this or that. I use the strategy to sometimes just read it again. And sometimes you will encounter things during the test that may help you. So yes… basically like that. (P9).

> I first try to structure the information. So, [for this assignment] I received a figure and a lot of text. Often, I then use letters to structure the text. For example, A plus B is C. (P7)

The excerpts illustrate two ends of a spectrum. The first excerpt demonstrates a student who did not use any specific strategies at all. The second excerpt demonstrates a student who used a specific strategy to tackle the question. In the middle of this spectrum, there were students who admitted that, although they knew they should use certain strategies to solve the questions, they did not use them during the task.

The majority of students admitted that they found the questions rather difficult, as they found analytical thinking, that is, to reason, difficult.

> I think we are trained in medical school to learn factual knowledge, and this [exercise] is a different skill than learning facts, or connecting facts, so… this is really a different skill, so I think that is always difficult, but it requires quite some brainpower. (P2)

In general, students felt that analytical reasoning was a competency not actively taught during medical training.

Evaluation

Evaluation refers to appraising the outcomes and regulatory processes after problem-solving. This includes, for example, evaluating one's goals and conclusions.[26] During the think-aloud assignment, few students evaluated their conclusions after marking one of the answer options. We prompted the students to evaluate by asking how sure they were of their provided answer. Despite this prompt, students spent little time evaluating their answers. Most students would answer the question "How confident are you that your given answer is correct?" without explicitly elaborating on their feeling of confidence or without checking their answer. During the interviews, most students described that a "feeling of logic" would determine their level of comprehension.

> Yes, if my feelings tell me that it [the answer] is not right but according to the formula it would be right, then I think, this is not right so I will doubt. Like, when it is not in accordance with each other, and if I cannot solve it with the formula and with my feelings, then I am not sure. (P6)

Other cues for comprehension included; time spent on task, familiarity with the learning material, and the ease of reasoning.

> I always notice that the longer I think about it, the more I start doubting. (P1)

> Yes, but you also think I really have known this [learning material]. I have really studied this and known this. I didn't know then if I was good at it, but yeah. (P2)

> I am sure when: this is how I reasoned and then I get to the right answer, then this seems the right answer to me. (P5)

The feelings of logic and familiarity with the learning material were often mentioned. Generally, these cues are bad predictors for the level of comprehension.[2,21] Rather, the ease of reasoning is well associated with one's actual level of comprehension, but this cue was mentioned to a much lesser extent.

Perceptions of self-regulated learning in the medical curriculum

During the interviews, the think-aloud data were enriched by asking students to reflect on the role of "knowing what you (do not) know" in the curriculum. Students said they valued the ability to accurately estimate their knowledge and skills so they know what they are (not yet) competent at. Most students outsourced this ability to external assessment tools. For example, they would mention both formative and summative exams, study assignments, and e-learnings as tools to estimate their level of knowledge or skills.

> Yes, you have mostly study assignments and practice exams of course which have a diagnostic value in terms of what knowledge you actually already possess. (P8)

A few students described the ability to accurately estimate one's knowledge as an internal, personal ability that could be developed by specific strategies, such as self-explaining, explaining to a peer, and consulting a teacher or other sources. The word "reflection" was rarely mentioned, and if it was, students indicated that focus on this competency during their medical training was insufficient.

> But at such a meta-level not really I think. That we really reflect on ourselves in terms of how well we understand something? How well do we understand exercises, or how well do we understand how we have to handle knowledge and things: I think that should be an essential component of an educational program, especially of an academic education. There is not enough attention paid to it [reflection] I think. We have to write reflection reports but you might

> as well just fill in three words, because the teacher is OK with it anyway. Yes, it is mainly just a fill in assignment, and not really that you, as a student, will take a look at yourself thinking what can I do better. And if you would take that maybe a little bit more seriously, also looking [as a teacher] what he [the student] actually does with it [the feedback], because that is being forgotten most of the time. (P8)

Students were in search of "hard outcome measures" (i.e. numbers) as they mentioned that they would appreciate having more insight into the status of their competences.

> Uh… with those competences, so competency-based education, really the practice-based education, I would have to admit that I find it really difficult to monitor my progress and how I have developed myself. That of course is one of the subjects during the teacher–coach conversations, but it is not very tangible. How good of a communicator, how good of a team player have I become during the last three years? I do not really have a clue, and I do not have any numbers either. (P7)

All students offered ideas in response to one of the questions on how we could enhance one's insight into one's learning during the medical curriculum. Students mostly mentioned that having more of the currently existing assessment tools (e.g. low-stakes exams, study assignments, and e-learnings) would provide more insight in one's knowledge deficiencies.

> But maybe if, for example, the self-study assignments or e-learning assignment are designed like the exam, it would be… but, then your learning is very exam-oriented maybe. (P2)

A few students elaborated on the benefits of intensifying feedback and reflection to facilitate personal continuous development.

> Well, actually we were talking about this yesterday in an educational committee. Longitudinal assessment and improving yourself and such… that more attention should be paid to that. And that you maybe can ask the students themselves or assess if… are they willing to improve themselves? (P8)

Finally, some students mentioned that medical education is solely about learning medical facts.

> To me, what I am learning is mostly about learning facts, and that is what's assessed really … I am not looking for any help [in learning facts], because it's things that I know or do not know. I don't think that anyone can help me to better learn things by heart, because I, that is one of my strengths, that I am good at learning things by heart. So, I don't really need help with that and I think that during my education that [learning facts] is what I mainly do for an exam, and in that sense, to a lesser extent understanding the material. (P7)

As illustrated by this excerpt, students felt that learning facts does not require self-regulated learning (e.g. help-seeking) and that learning facts is sufficient to succeed in the pre-clinical phase of medical school.

Discussion

Our study provided insight into medical students' metacognitive skills, knowledge, and experiences. Additionally, we obtained students' perceptions of self-regulated learning in the medical curriculum. Regarding metacognitive skills, students used various ways to monitor their learning process while problem-solving. For example, they visualized the situation to make the problem less abstract. Contrary to monitoring, less time was spent on planning and evaluating. Previous research on metacognitive skills in clinical reasoning has also shown that students perform monitoring, but that planning occurs to a much lesser extent.[29] Planning and evaluation are strong predictors of academic performance.[30–32] Importantly, these skills are modifiable and teachable, rather than fixed traits.[7] Tanner has provided examples of self-questions that learners may ask in training their metacognitive skills, either on the level of an assignment, a single class session, an exam, or a full course.[33] These questions are not only helpful for learners, but also serve as a tool for educators who aim to address metacognitive skills explicitly in their classrooms.

Regarding metacognitive knowledge, a large variety in awareness about one's learning process was found. For those students with little metacognitive knowledge about types of skills or how to use them, there is a need to teach this explicitly.[17,33] Moreover, educators should be aware of students' prior knowledge about a subject before teaching them new information. For example, preassessments may be very valuable tools in encouraging students to examine their level of knowledge, and for educators as a diagnostic tool to gain insight in students' understanding.[34] Educators should take responsibility, especially since we know from literature that students themselves are rather poor judges of their actual knowledge and competencies.[34,35]

Regarding metacognitive experiences, most students estimated their performance based on a feeling of logic or a feeling of familiarity, and to a lesser extent on the ease of reasoning. The first two can be referred to as surface-related cues that operate automatically

and unconsciously, and which are generally unreliable as predictive cues for performance.[20,21] Importantly, learners can be trained to effectively use predictive cues such as comprehension-based cues (e.g. ease of reasoning).[20,36] Various examples of training methods include generating keywords or summaries in the case of learning factual knowledge, and completing diagrams in the case of conceptual knowledge.[37,38] Teaching students explicitly to recognize and generate predictive cues in the classroom may eventually lead to enhancing predictive cue use during self-regulated learning outside of the classroom.[2]

The scale of this research was necessarily small as is the nature of exploratory research in areas like metacognition. A useful progression would be to ascertain how to assess these skills and their use *in situ*, so that learners can receive feedback on their use of skills with concomitant activities to assist the ongoing development of these skills.

Facing the facts

During their medical training, students continuously have to prove themselves, resulting in their learning being driven by assessments.[39,40] Our research confirms this in students' descriptions of the value they assigned to assessment outcomes. They felt that assessments were the main indicators for performance. Regarding competency-based education specifically, students felt they had no insight in their level of competency as they could not fall back on any numerical indicator of performance. The impact of assessments on medical students' motivation to study is profound and often leads to a surface approach to learning.[39,41,42] This surface approach is characterized, for example, by students' aim to memorize facts.[43] Notably, our students underlined this statement by describing that the focus in pre-clinical medical training is on learning factual knowledge. They felt that this approach to learning came at the cost of their reasoning abilities. Even clinical "reasoning" is described by some students as a process of pattern recognition during which one has to merely recall factual knowledge.

The medical education community has already suggested that one of the solutions to establish deep-learning might entail more integration of basic science and clinical learning, which would meet the students' needs for conceptual knowledge to better understand medical concepts.[44] Additionally, because assessment drives learning, educators and faculty should better align assessments with the skill sets required for practice. If assessment of metacognition and self-regulated learning were part of the regular assessment schedule and contributed to grades, one might well get greater attention placed on this important aspect of learning by all parties. An example of integrating metacognitive performance in the assessment schedule is to introduce the use of reflective journals.[33] But assessments are not the only solution toward stimulating metacognitive development among students. Other strategies include the use of self-questions that explicitly activate students' prior knowledge and help them in thoughtful planning of how to approach a new learning topic.[33] Further, as also desired by participants in our study, there is a trend toward integrated longitudinal assessment programs that facilitate a more continuous evaluation of student abilities, and which aim to produce competent lifelong learners. The integration of meaningful assessments by defining metacognitive performance indicators against which students can assess their competencies will help our students become lifelong learning health professionals.[40,45]

Strengths and limitations

A strength of our study lies in combining the think-aloud assignment with an interview session. This approach allowed us to better grasp all three facets of students' metacognitive performance. It also functioned well as a prompt for students' thoughts about self-regulated learning on the curriculum level. However, some limitations must be taken into consideration. First, the study was conducted in a non-authentic setting, meaning that contextual factors from a real environment which may influence learning behavior and performance were excluded. Still, students were very inclined to perform well and worked on the learning task very seriously although there was not any grading involved. Second, metacognitive skills were measured without explicitly asking our students about these skills during the task. This is contrary to the use of microanalyses, defined as "structured interview approaches that involve administering context-specific questions targeting multiple cyclical phase processes as trainees engage in authentic activities."[46] These microanalyses are often used to measure self-regulated learning processes and prompt students to focus on strategic steps during problem-solving.[29] However, such prompts may trigger students' awareness and induce "artificial" use of metacognitive skills as they may not have used these skills in a non-prompted setting. We therefore argue that our

approach leads to a more accurate image of students' use of metacognitive skills. Yet, we cannot rule out the possibility of an "underestimation" due to this method because we can only approximate students' thoughts and cannot guarantee that they vocalize all their metacognitive strategies and experiences.

Our study was performed among final year pre-clinical medical students in a Dutch University. As always in qualitative research, caution is advised in transferring the results to other contexts. Despite this specific context, we argue that our findings are transferable within the Dutch educational context as all Dutch medical programs are based on the same blueprint as developed by the Dutch Federation of University Medical Centers.[26] This blueprint promotes transferability as the formulated objectives for pre-clinical training are very specific and concrete. Further, the study was performed in a CanMEDS-based curriculum with high-stakes knowledge-driven exams, which promotes transferability to other CanMEDS-based curricula around the world. However, cultural and socio-economic differences between countries and their curricula should always be taken into account when interpreting and transferring our outcomes. Lastly, transferability of this study is supported by the use of widely acknowledged theoretical concepts of metacognition and self-regulated learning. By applying these recognized concepts, our research may provide a starting point to perform future qualitative studies on metacognitive competencies in different international contexts.

Conclusion

This study revealed that medical students are in need of explicit training and assessment of metacognition to facilitate self-regulated learning. Moreover, findings showed that the CanMEDS-based curriculum, including supportive educational activities (e.g. coach conversations, reflective essays) were not aligned or did not trigger the development of metacognitive skills. If curriculum design remains unchanged, implementation of explicit teaching of metacognition could still not yield the desired effects. Educators and faculty should aim to integrate metacognition in the everyday discourse of the classroom to foster an environment in which students discuss their own cognition and learning. This includes the use of novel assessment strategies that drive both cognitive and metacognitive learning in order to develop metacognitive habits of mind and stimulate lifelong learning.

Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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