An Investigation of the Metacognitive Awareness of Postbaccalaureate Premedical Students at Indiana University School of Medicine

[1]Da'Quan D. Craven, [1]Jessica N. Byram

[1]Indiana University School of Medicine, Department of Anatomy, Cell Biology, & Physiology, Indianapolis, Indiana

INTRODUCTION

Medical school curriculum is tasked with producing lifelong self-directed learners, a set of characteristics requiring strong metacognitive skills. Metacognitive skills directly impact students' metacognition, which is their ability to understand and regulate their own thinking and learning. It may then be postulated that metacognition may be key in distinguishing students that require a postbaccalaureate program from those that do not. Metacognition has two critical domains: *metacognitive knowledge* and *metacognitive regulation*, each of which contain multiple subprocesses. Metacognitive knowledge includes knowing strategies for learning, when to use those strategies, and knowing oneself as a learner. Metacognitive regulation includes strategies for planning, monitoring, evaluating, and debugging learning strategies. Therefore, the purpose of this study is to investigate: 1) the impact of a graduate TBL course on students' metacognitive awareness, and 2) the relationship between metacognition and course performance.

METHODS

Students enrolled in a TBL graduate histology course at Indiana University took part in this study.

1. Students completed a 19-item Metacognitive Awareness Inventory (MAI) at the beginning (MAI1) and end of the semester (MAI2). The MAI has two domains, Knowledge (8 items) and Regulation (11 items), where items are rated on a 5-point scale from "not at all typical of me" to "very typical of me."
    I. Free response questions asked about knowledge and study abilities, plans for studying in histology and how study skills and abilities have improved across the semester.
2. Finally, students completed a voluntary reflection about their examination performance after the first unit exam.

Differences between MAIs were investigated using a Wilcoxon signed-rank test. Spearman's correlations explored the relationship between MAI and final course grades. MAI free responses and exam reflection were analyzed using thematic analysis. Responses were coded using a conceptual framework of metacognition based on processes of knowledge and regulation.

RESULTS

Participant Demographics

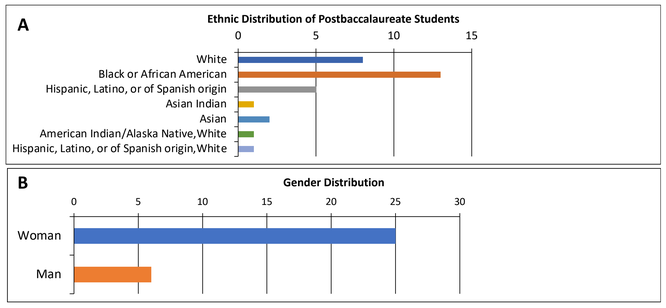

Figure 1. Demographic Distribution of Postbaccalaureate Premedical Students Participating in this Analysis. A) Ethnic distribution of the 31 students that completed both the MAI 1 and the MAI 2: White= 8, Black= 13, Hispanic/Latinx= 5, Asian Indian= 1, Asian= 2, Am. Indian/Alska Native= 1, and Hispanic/Latinx, White= 1. **B)** Gender distribution of the study participants: 25 women and 6 men.

MAI 2 Knowledge Domain Correlates with Final Grades

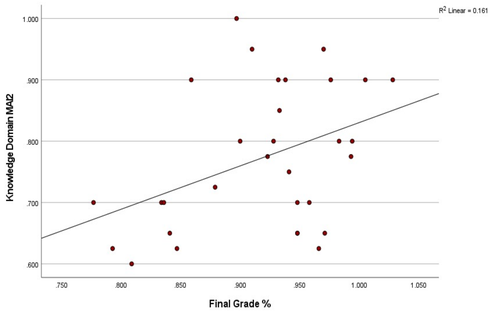

Figure 3. Weak Positive Correlation Between Knowledge Domain of MAI 2 and Final Grade. A weak positive correlation between the knowledge domain of students' MAI 2 scores and final grades when using a 2-tailed Pearson's correlation in SPSS. Pearson's r= 0.450 with p= 0.025.

Coding Framework and Participant Exemplars

	Knowledge		Regulation		
	Definition	Participant Exemplar		Definition	Participant Exemplar
Declarative	knowledge of one's skills, intellectual resources and abilities as a learner.	*I general would say that I am a strong student when I am feeling motivated to learn and well supported. I am able to catch on to new concepts quickly and conceptualize things well in my head, but if my motivation is low this adversely impacts my performance in a class."*	Planning	Planning, goal setting, and allocating resources prior to learning.	*To learn the content in HIAA1 DSO2, I plan to revisit TBL notes and laboratory modules often. Dr. Byram provides amazing resources and explanations of the material; I already have learned so much in the first few weeks just by reading and utilizing those sources alone. I plan to also expand my learning by utilizing the textbook and other resources (such as youtube videos) extensively, for they can help me better solidify concepts. I think repetition is key in this course - the best way to learn is to continuously revisit and review concepts learned in class over the weeks. I do hope to be better about skimming content for the next week sometime during the week before though, so I can up that exposure and repetition.*
Procedural	Knowledge about how to implement learning procedures (e.g. strategies).	*I re-review slides/PDFs/notes every day from previous classes and the upcoming class, re-draw diagrams on any processes in my own words, ask myself questions about what I'm reading, make index cards for the details, and then further test myself on other slide boxes.*	Information Management Strategies	Skills and strategy sequences used to process information more efficiently (e.g., organizing, elaborating, summarizing, selective focusing).	*I am a visual learner so the practical content was usually the easiest for me, but I struggled with the written content. I started making fill-in-the-blank versions of the notes and that helped me a lot. I also would get together with others and we would create quizzes for each other and that was probably the most effective way I learned.*
Conditional	knowledge about when and why to use learning procedures	*- I pay attention to details, which I believe is important when it comes to the images introduced in lab. - I make it a point to integrate my physiology content with histology since much of the material overlaps; this constant repetition and exposure to the material makes memorizing effortless. -I am self aware that some learning methods are tedious, for example, creating written summaries of content but it works for me. I tend to memorize content better on paper than on a screen.*	Monitoring	Assessment of one's learning use or strategy use.	*I had not realized how visual I am. I noticed I started to understand and retain more information from my TBL notes when I started integrating images into my notes.*
			Debugging Strategies	Strategies used to correct comprehension and performance errors during a learning episode.	*I re-review slides/PDFs/notes every day from previous classes and the upcoming class, re-draw diagrams on any processes in my own words, ask myself questions about what I'm reading, make index cards for the details, and then further test myself on other slide boxes. This is my plan after not performing well on the physiology exam. Prior to that I was only doing index cards and had a bit of trouble running through the content more than once.*
			Evaluation	Analysis of performance and strategy effectiveness after a learning episode.	*The approaches I used to learn the content in DSO2 are the approaches I use in all of my classes – which is to read over notes and watch required + supplemental videos. It worked effectively for this course this semester, due to the fully online format; I wonder if things would have been different for me if we were in class, assuming we would have been more hands-on and have more discussions? Regardless, I believe my approaches in learning DSO2 content were effective, demonstrated by the exam grades I ended up receiving over the course of the semester. I always personally wonder if my studying techniques and intonement would change if I were to write my notes down on paper, but I just have rarely done that for courses that are not "iverded" (in my opinion).*

Table 1. MAI Open-ended Coding Framework. The MAI open-ended question responses were coded using this framework that was adapted from Saricoban, 2015.

Metacognition Quantitative Evaluation

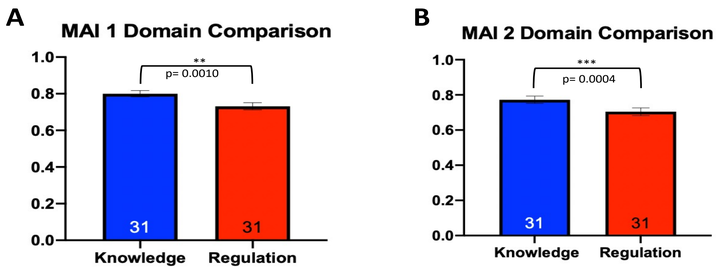

Figure 2. Knowledge domain versus regulation domain for MAI 1 and MAI 2. Students' MAI scores were calculated as percentages out of 95, the highest possible score on the MAI. MAI total scores were disaggregated into the two key domains of metacognition: Knowledge and Regulation. **A)** The MAI 1 average was 0.8 (80%) for the knowledge domain and 0.73 (73%) for the regulation domain. **B)** The MAI 2 average was 0.77 (77%) for the knowledge domain and 0.70 (70%) for the regulation domain. For these analyses, mean scores were compared using the Wilcoxin signed-rank test at a 95% confidence level. Data are displayed with ±SEM (standard error of the mean).

Final Grades and MAI Subdomains

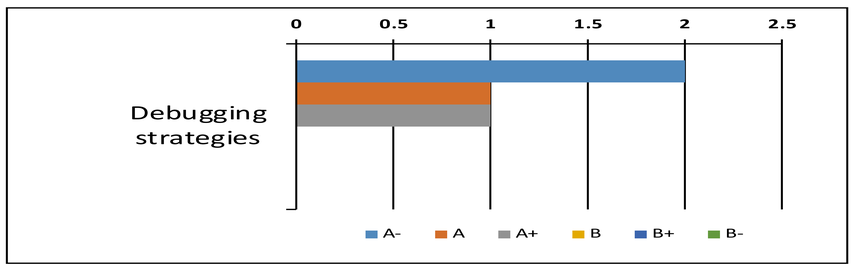

Figure 4. Grade distribution for Debugging Strategies Subdomain. While only 5 students had responses that coded into the debugging strategies subdomain, all five of these students earned a final grade of A in the course. This may be a potential domain worth focusing on in future studies.

DISCUSSION

- There were no racial or gender differences in MAI total scores, domain scores, or subdomain scores
- While the MAI failed to demonstrate improvement in metacognition, students reported an increase in their ability to adapt study strategies to their learning.
- Educators using TBL in their classrooms may need to provide students with additional resources and strategies to regulate their own learning, as evidenced by:
    a. Students consistently scoring themselves higher in the knowledge of cognition domain compared to regulation
    b. Students' responses to questions regarding their learning in the course falling primarily in the declarative knowledge subdomain
    c. The fact that when debugging strategies were mentioned, they were always mentioned by students with an A grade in the course
- Future studies aim to to investigate the validity of the MAI for measuring metacognition in anatomy courses, and the impact that explicit metacognitive instruction using journaling throughout the semester will have on MAI scores and survey responses.

REFERENCES

1. Harrison GM, Vallin LM. Evaluating the metacognitive awareness inventory using empirical factor-structure evidence. *Metacognition Learning*. 2018. 13, 15–38. https://doi.org/10.1007/s11409-017-9176-z
2. Sarıcoban A. Metacognitive Awareness of pre-service English Language Teachers in Terms of Various Variables. *Procedia - Social and Behavioral Sciences*. 2015;186:664-669. doi:10.1016/j.sbspro.2015.04.135
3. O'Loughlin VD, Griffith LM. Developing Student Metacognition through Reflective Writing in an Upper Level Undergraduate Anatomy Course. *Anatomical Sciences Education*. 2020;13(6):680-693. doi:10.1002/ase.1945