

Use of Examination Wrappers to Direct Student Self-Assessment of Examination Preparation: A Pilot Study

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ABSTRACT

Metacognition is the act of thinking about one's own thought processes. There are long-term gains in learning among students who are trained to understand how the brain works and how they can control their own learning. Wrappers are short questionnaires provided at or near the time of completion of a lecture, assignment, or assessment to coach the student in thinking through the steps of metacognition (planning, monitoring, and adapting). As students completed the second and third of four examinations in a first-year veterinary anatomy course, they were invited to fill out an examination wrapper that asked them questions about examination preparation, where they felt they had had the most trouble with the examination, and what they might do differently before the next examination. Neither percentage change in scores from the second to the third and from the third to the fourth lecture or laboratory examination nor final grade for the course varied between the group of students who completed an examination wrapper and the group that did not. Students did not appear to change their behavior from one examination to the next. This was most likely because students lacked formal training in metacognition and therefore did not understand the value of completing the examination wrapper or the potential benefits of using their reflections. Future work will describe outcomes when learning objectives specific to metacognition are included in coursework in the veterinary curriculum.

Key words: anatomy, assessment, metacognition, wrappers

INTRODUCTION

Metacognition is defined as the act of thinking about one's own thought processes.¹ Student beliefs about learning can alter their ability to understand and retain information.² Students who believe that intelligence is malleable and that they can succeed through hard work tend to be stronger academically.^{3,4} There are long-term gains in learning among students who are trained to understand how the brain works and how they can control their own learning.²

Students can be trained in metacognition, which includes skills such as planning and goal setting, monitoring progress, and adapting as needed.² In a study evaluating use of examination wrappers in several courses of varying disciplines, students who took the most courses containing information about metacognition showed the greatest gains in metacognitive skills, suggesting that these skills can be taught like any other and that students benefit from practice and feedback.⁵ A study evaluating the effects of teaching metacognition within the first year of a medical school curriculum demonstrated a strong positive correlation between student knowledge of metacognition and academic performance.⁶ This may be because metacognition makes students more efficient. If students can be

trained to recognize what information they truly understand, they can spend more time and effort on those things they do not understand.⁷

Metacognition is best taught by embedding it within coursework so students can practice the skills and see immediate changes in their academic performance within the discipline of the course.⁸ Students in a foreign language class showed greatest academic gains when their training in metacognition was most overt, including post-test reflection and explicit discussion of study skills in class.⁹ Ideally, metacognition exercises should not take away from time for primary course content, they should be of an appropriate length so that students are willing to complete them, and they should provide repeated opportunities for students to practice skills.⁵

One mechanism for teaching metacognition that meets these criteria is the use of wrappers. Wrappers are short questionnaires provided at or near the time of completion of a lecture, assignment, or assessment to coach the student in thinking through the steps of planning, monitoring, and adapting. A lecture wrapper might consist of questions about how students prepared for class and what key points they took from the lecture, followed by a large-group discussion of the instructor's key points so

that students can self-check and determine what they might do differently before the next lecture.² Research shows that this is an efficient way of helping students consider how best to learn the material being presented.² Over the course of a semester, less and less prompting is required by the instructor for students to complete this successfully.²

Examination wrappers consist of questions about examination preparation, what kinds of errors students made on the examination, and what they might do differently to prepare for the next examination.⁵ Ideally, examination wrappers are given to students immediately after they get back their graded examination and then returned to them well before their next examination. This structured reflection prompts students to work through the cycle of meta-cognition by considering their planning, assessing their achievement, and adapting as they plan for the future. Undergraduate students using examination wrappers have demonstrated the ability to self-identify new approaches for examination preparation with the majority reporting use of new strategies on subsequent examinations.²

In the present study, we addressed the following research questions:

- Do students who complete an examination wrapper and get it back before the next examination show an increase in percentage points on that following examination compared to those who do not complete an examination wrapper?
- Do students who complete an examination wrapper at least once do better in the course than students who do not complete any examination wrappers?
- How do students prepare for examinations? If they fill out multiple examination wrappers, do they fulfill their intentions regarding how they will change preparation for the next examination?

MATERIALS AND METHODS

The Institutional Review Board of the authors' institution approved this study. All students in a first-year veterinary anatomy course were invited to participate in a research study evaluating use of examination wrappers (short post-exam surveys) as a way of helping students improve the efficiency and effectiveness of their examination preparation. This course is the first in a two-semester series. Primary course content included gross anatomy of carnivores using dogs and cats as models; developmental anatomy in all animal species; and radiographic anatomy in dogs and cats, including radiological principles, radiation safety, and mastery of normal radiographic anatomy on survey films and contrast films. Course activities included lecture and laboratory. Both face-to-face lectures and online course content were available to students. Laboratory experiences included dissection of fixed dog and cat cadavers; availability of preparatory laboratory dissection videos, prosections, and bone boxes; and radiography laboratories. Students were expected to demonstrate understanding of typical canine morphology and rela-

tionships between structure and function, and to apply anatomic knowledge when discussing the literature or information from other courses. Procedural skills to be mastered by students included dissection technique and handling of surgical instruments. Non-technical skills to be mastered by students included correct pronunciation and use of anatomic terms and ability to work effectively within a team. Achievement of learning objectives was assessed by lecture- and laboratory-based examinations.

As students completed the second of four summative examinations in the semester, they were invited to fill out an examination wrapper that asked them questions about examination preparation, where they felt they had had the most trouble with the examination, and what they might do differently before the next examination (Appendix 1). The examination wrapper was handed out to all class members as a hard copy while they completed the examination. This signed examination wrapper was to be placed by the student in a secure faculty mailbox within 24 hours. Completed examination wrappers were returned to students in their mailboxes approximately 1 week before the next examination and the students received a reminder about the study. The process was repeated immediately after the third examination. Time between the second and third examinations was 28 days and time between the third and fourth examinations was 18 days.

Examination and course grades were compared between those students who completed examination wrappers and those who did not. We used the student's non-paired *t*-test, with significance set at .05.

RESULTS

There were 98 students enrolled in the course. Of these, 16 (16.3%) were male. Forty-three students completed the first examination wrapper and 16 completed the second examination wrapper. Fifteen of the students in this latter group completed both examination wrappers. Two male students (4.7%) completed the first examination wrapper and one male student (6.7%) completed the second. Student representation across all four academic quartiles based on cumulative first-semester class rank was uniform. Of students completing the first examination wrapper, 9 (20.9%) were in the first quartile, 9 (20.9%) were in the second, 13 (30.2%) were in the third, and 12 (27.9%) were in the fourth. Of students completing the second examination wrapper, 5 (31.3%) were in the first quartile, 4 (25.0%) were in the second, 3 (18.8%) were in the third, and 4 (25.0%) were in the fourth. Percentage change in scores from the second to the third lecture or laboratory examination and from the third to the fourth lecture or laboratory examination did not vary by group, nor did final grade for the course (Table 1).

Students spent 15.7 ± 5.2 hours preparing specifically for the second examination and 16.7 ± 6.6 hours preparing for the third examination. Students were more likely to study in a group than to study alone. They worked with formal groups offered through the college and with

Table 1: Change in examination scores and mean total percentage score in the course (mean \pm SD) after completing no examination wrappers or completing one or more

	Change in individual student score from second to third examination	Change in individual student score from third to fourth examination	Individual student total score for the course (% of total points)
Completed no examination wrappers	4.4 \pm 7.4 (55)*	-2.3 \pm 7.2 (82)	88 \pm 6 (82)
Completed one or more examination wrappers	5.5 \pm 7.0 (43)	-4.0 \pm 5.8 (16)	89 \pm 5 (16)

* sample size in parentheses

informal groups of colleagues (81.4% for first examination wrapper, 56.3% for second examination wrapper). Their study techniques included review of class notes, completion of study guides, review of dissection videos and images, review of laboratory specimens, review and quizzes from online resources,^{a,b} creation and review of flashcards, rewriting notes or creating notecards, creating or reviewing pictures or drawings, and reading textbooks. Students were somewhat likely to have some sort of television, radio, streaming video, or other media on while studying (55.8% for the first examination wrapper and 37.5% for the second examination wrapper), with most declaring that music was needed to provide background noise. Social media were completely avoided by 51.2% of students completing the first examination wrapper and by 50.5% of students completing the second. Of those who accessed social media while studying, the majority stated that they only accessed it during breaks in study. Students who completed the first examination wrapper got 5.6 \pm 1.6 hours of sleep the night before the examination (range of 0.5–8 hours) and those completing the second examination wrapper got 5.6 \pm 1.7 hours (range of 2–8 hours).

Regarding self-assessment of trouble with the examination, those completing the first examination wrapper most commonly cited lack of understanding of concepts and expressed concerns about unpreparedness for the examination format and about confusing questions on the examination. Students completing the second examination wrapper most commonly cited careless mistakes, lack of knowledge of basic structures, and insufficient time to prepare for the examination.

When asked what they would do differently to prepare for subsequent examinations, the most common responses from students completing the first examination wrapper were to start preparing earlier and to stay current by reviewing after every laboratory session. Other responses included studying class notes, cadavers, or diagrams more; studying more broadly; studying in more detail; and getting more sleep. Five respondents said they would do nothing differently. For students completing the second examination wrapper, the most common responses were the same as above, with three respondents saying they would do nothing differently. Responses were compared for those 15 students who completed both examination

wrappers. Change in time spent studying for the examination averaged less than one hour with a wide range (0.4 \pm 5.7 hours, range of 6 fewer to 12 more hours of preparation time). There was virtually no change in amount of sleep (-0.2 \pm 0.6 hours, range of 1.5 fewer to 1 more hour of sleep). Five respondents (33.3%) did fulfill some of the goals they voiced when completing the first examination wrapper. For example, one student wrote “don’t cram” on the second examination wrapper, and then reported spending “more time in lab and studying in group” on the third examination wrapper. A student who had stated the need to “study cadaver more” later wrote, “watched dissection videos, went into lab.” Eight respondents (53.5%) did not demonstrate having fulfilled study goals. For example, several students noted that they wanted to “start studying earlier” but still listed “start studying earlier” under plans for the future. Similarly, one student had a goal to “spend more time working on remembering things” but listed “not remembering things” as a primary concern when self-assessing examination performance.

DISCUSSION

The primary limitation of this study was that it involved only one cohort of students and that those students were not specifically trained in metacognition; the course did not include acquisition of metacognition skills among its learning objectives. A secondary limitation was the limited number of students who participated, especially in completing both examination wrappers. Male students were underrepresented, but the significance of this in potentially biasing the results is unknown. There was uniform representation by academic ability. The authors believe that this is a good course in which to embed information about metacognition because gross anatomy is often difficult for veterinary students. All veterinary students are high-achieving students and may not have the skills to readily change study habits or personal management to address their lack of autonomy in the traditional lock-step curriculum and the heavy academic load of veterinary training.¹⁰

An unexpected benefit of having students complete examination wrappers was that it allowed the instructors to see how students prepared for the examinations and

where they perceived themselves to be having trouble. For example, students valued formal group work and completion of study guides, making it clear that these efforts are worthwhile for guiding and enhancing student learning.

In this study, students did not appear to change their behavior from one examination to the next. This may be an artifact due to small sample size. Alternatively, it is likely that students simply had no time to implement changes. For example, while a proper amount of sleep has been associated with increased memory and increased learning, students with a heavy academic load and personal and work responsibilities may truly be unable to find more time to sleep during the school year.¹¹ Medical students in one study demonstrated consistent study techniques when learning anatomy and physiology; these included reviewing lecture notes, completing learning exercises, taking practice examinations, and creating drawings and diagrams.¹² In that study, those students who made the greatest changes in study habits had the greatest decrease in grades, suggesting that it is better to counsel students to use a few study techniques well rather than to try to greatly increase or change what has traditionally been successful for them.¹²

CONCLUSION

Students in this cohort who completed at least one examination wrapper did not show an increase in examination scores compared to their classmates who did not complete any examination wrappers. This was most likely because students lacked formal training in metacognition and therefore did not understand that they were completing the three steps of planning, monitoring, and adapting. Future work will describe outcomes when learning objectives specific to metacognition are included in coursework in the veterinary curriculum.

NOTES

- a Colorado State University Veterinary Educational Tools (<http://www.cvmb.colostate.edu/vetneuro/>)
- b University of Minnesota Veterinary Anatomy (<http://vanat.cvm.umn.edu/>)

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APPENDIX I: EXAMINATION WRAPPER

Please provide your best estimate for each of the following:

Approximately how much time did you spend specifically preparing for this exam?

For this exam, how much time did you spend reviewing class notes?

For this exam, how much time did you spend watching captured lectures?

Did you work with a study group (Jump Start, informal study group with classmates)?

What other study techniques did you use to prepare for this exam?

Was the television, radio, streaming video, or other media on while you studied?

Were you on any social media site while studying?

How much sleep did you get the night before the exam?

Where did you have the most trouble (please choose only one)?

- Careless mistakes
- Lack of understanding of concepts
- Lack of basic knowledge of structures
- Difficult with vocabulary
- Other reasons (please specify)

Based on this information, what will you do differently next time?
