

Evaluation of Veterinary Medical Student Retention of Pre-clinical Concepts with Various Experiential Learning Methods

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ABSTRACT

Many veterinary medical colleges have undergone curricular changes that have moved away from traditional lecture-based teaching in favor of evidence-based, experiential methods of instruction. Such a curricular reinvention occurred in 2018 at Michigan State University's College of Veterinary Medicine, with individual courses using numerous instructional and learning methods. In the present study, three courses were assessed, two of which used a method of experiential learning, and the other utilizing a traditional lecture approach. The purpose of this study was to determine if the method of instruction impacted exam grades, content retention, and student perspective. Methods of teaching and learning were quantified for each course using the Classroom Observation Protocol for Undergraduate STEM. Following completion of each course, participants ($n = 27$) retook the same final examination and participated in a survey 5 weeks later so their perspective could be evaluated. Mean scores on the initial examinations in the experiential learning courses were significantly higher than the mean score of the traditional lecture course ($p = .01$). However, mean retake examination scores were similar for all courses ($p = .76$). Students reported more confidence with course materials and examinations in courses that incorporated active learning strategies. Although true retention is difficult to assess in veterinary medicine, evaluation of student perspectives suggests the use of experiential learning methods primarily or in combination with lecture-based material to support student learning of pre-clinical concepts. Future controlled studies are needed to evaluate veterinary students' short- and long-term learning and retention.

Key words: experiential learning, material retention, veterinary education reform

INTRODUCTION

It is no secret that advances in technology are causing the field of medicine to grow rapidly.¹ Future health care professionals and educators must understand these changes in order to continue to prepare the next generations. With these technological advances, education and methods of instruction are changing as well. Veterinary medical education is one area currently facing the need for curricular change to produce and prepare next-generation veterinarians. Shifts in society and the environment have made it evident that veterinary medical education requires reform to “prepare new veterinarians for what might come in the future, not for what can be seen now.”^{2(p.6)} In general, recommended curricular changes based on the ever-evolving field of human medical education include moving from a “comprehensive mastery of basic knowledge” to a “selective substantive mastery of only foundation knowledge” and from lecture-based didactics to problem-based didactics.^{3(p.80)} This recommendation comes from the understanding that for information to transfer out of school, teaching needs to occur in a way to enhance that goal.⁴

Michigan State University's College of Veterinary Medicine underwent a curriculum reinvention in 2018 for its Doctor of Veterinary Medicine (DVM) degree. The purpose of this was to “focus on real-world application, [and] mov[e] away from straight lectures.”⁵ The curriculum moved from a traditional lecture-based education to a flipped classroom approach where students are expected to come to class prepared to apply what they have learned to case studies, discussion

sessions, or other hands-on activities. This change promoted the incorporation of various experiential learning activities to promote the growth and development of career-ready veterinarians. In this updated curriculum, students in the pre-clinical portion (years 1 and 2) take individual systems-based courses supplemented with longitudinal yearlong courses focusing on communications, professionalism, and career and practice management. This structure was designed for course content to build on one another with each year of the curriculum. Students are presented with normal structure and function in the first year of the program, and in the second-year, students apply that knowledge to understand, recognize, and plan interventions for patients who have abnormal anatomy and physiology. Students spend the last 2 years of the program split between didactics and clinical education, with a focus on practical application of prior course material.

A multitude of different active and experiential learning methods have proven to be beneficial for human and veterinary medical education.^{3,6,7} Problem-based learning strategies are recognized for their simulation of real-life scenarios, with promotion of independent learning and application of prior knowledge.⁷ Similarly, case-based learning promotes critical thinking but with the expectation that students already have a specific foundation of knowledge.⁸ With these different strategies in mind, and in the interest of protecting the faculty's academic freedom to determine individual course content and teaching, instructors were able to choose their desired teaching and learning methods for the course(s) to which they were

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assigned. This resulted in the delivery of a diverse set of courses, with many employing case-based and problem-based learning and some still including a significant amount of didactic lecture material.

This pedagogical change provoked a question regarding material retention in veterinary education with different methods of experiential learning, specifically regarding which one(s) may be best suited for pre-clinical veterinary student learning and retention. This study aimed to compare different methods of experiential learning in how they affect veterinary medical students' retention of material and student experience. In addition to providing insight and feedback after the inception of this curriculum, specific objectives were to do the following:

1. compare the efficacy of three methods of instruction on retention by delivering the same examinations after a set period, and
2. assess student perception of their own ability to retain information based on major method of instruction in a course.

MATERIALS AND METHODS

This was a cross-sectional, observational study evaluating three courses of the first-year DVM program at Michigan State University. Twenty-seven first-year students of the class of 2024 (out of a class of 115 students) voluntarily participated in the study following consent and approval by the Michigan State University Institutional Review Board (IRB approval #STUDY00005485). Student participation was not incentivized.

Three 3-week courses with different instructional approaches were analyzed: the Respiratory System course (RSC), the Digestive System course (DSC), and the Immunologic and Hematologic Systems course (IHSC). The RSC mainly employed a hands-on, discussion-based instructional approach, the DSC mainly used a case-based instructional approach, and the IHSC mainly used a lecture-based instructional approach (Table 1).

The RSC had nine summative examinations throughout its entirety. For the retake examination, students took a combination of the nine summative examinations 5 weeks after the last day of the course, which consisted of 85 multiple-choice/true-false questions and 10 short-answer questions. The DSC and IHSC had a standard final examination at the end of the course, and 5 weeks after the original final exam, study participants retook the same final examination with questions reordered. The DSC examination consisted of 54 multiple-choice/true-false questions and 2 short-answer questions. The IHSC examination consisted of 56 multiple-choice/true-false questions and 4 short-answer questions. All quizzes and examinations were administered within secure lockdown browsers via Desire2Learn^a or Examsoft.^b Score reports were securely provided to the primary investigator after removing all personal

identifying information and new assignment of randomly generated numeric identifiers.

Statistical analysis was performed using GraphPad software.^c Student grade data were assessed for normality using D'Agostino–Pearson testing and were normally distributed. Exam score data are presented as means and were compared using paired *t*-tests and repeated-measures one-way ANOVA, as appropriate, with alpha set to .05.

Courses were analyzed using the Classroom Observation Protocol for Undergraduate STEM (COPUS) to quantify what students and instructors were actively doing during a set class period. COPUS was created for outside observers who underwent two sessions of training to analyze class sessions and determine what students and teachers were doing in a class period. This process involves sorting out time spent in discussions, lectures, worksheets, tests, and quizzes.⁹ Random 50-minute recorded sessions from each course were chosen for retrospective review and analyzed as previously described, with percentage of time spent on student and teacher activities reported by a single independent observer. Due to the possibility of having simultaneous activities, the cumulative percentage may be greater than 100.⁹ Recordings were chosen randomly from the complete list of the class, and period recordings were made as previously described.¹⁰

Study participants were provided an anonymous Likert-style questionnaire following the conclusion of the retake examinations regarding each course's presentation of material, their confidence in taking both examinations, and their thoughts regarding different experiential instruction methods (Table 2). The Likert-style questionnaire was made and distributed using Qualtrics.^d The questionnaire was then analyzed using a thematic analysis as described by Maguire and Delahunt.¹¹

The entirety of this study took place during the COVID-19 pandemic; thus, all interactions between students and their professors were done via videoconferencing technology.^e All interactions with study participants occurred via online communication.

RESULTS

COPUS Analysis

Full descriptions of time spent in different instruction methods and learning methods can be found in Table 3. RSC utilized experiential instruction methods for over one third of the observed class time. In the RSC, 36% of the class session was spent in a whole-class discussion (18 mins.), and 16% (8 mins.) was spent in a group activity. The rest of the class time was spent on student-posed questions, individual thinking, and listening to the instructor. The DSC also utilized experiential learning methods for over one third of the observed class time, including answering questions posed by the instructor out loud and through iClickers^f (48%, 24 mins.), and other group activities (32%, 16 mins.). Other time in the class was spent listening to the instructor about concepts and administrative duties and waiting during iClicker questions. Analysis of the IHSC showed that 96% of the observed class time (48 mins.) was spent in lecture, with few student questions and instructor-posed questions interspersed in the 50-minute period.

Original and Retake Examinations

Results from the individual RSC summative examinations were averaged for each student and then averaged for the group of 27 students. The average score was compared with

Table 1: Three Michigan State University College of Veterinary Medicine first-year courses and primary methods of instruction, 2021

Course Name	Acronym	Method of Instruction
Respiratory System I	RSC	Discussion-based
Immunologic and Hematologic Systems I	IHSC	Lecture-based
Digestive System I	DSC	Case-based

Table 2: Likert-style questionnaire administered to students

Question	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
When taking the course, I was able to understand the presented information to me in [topic area listed below]:					
Digestive I	1	2	3	4	5
Based on your above rating, why did you select this value?					
Immunology/Hematology I	1	2	3	4	5
Based on your above rating, why did you select this value?					
Respiratory I	1	2	3	4	5
Based on your above rating, why did you select this value?					
When taking the original final for the course (during the course), I felt confident with my ability to answer a majority of the questions in [course listed below]:					
Digestive I	1	2	3	4	5
Based on your above rating, why did you select this value?					
Immunology/Hematology I	1	2	3	4	5
Based on your above rating, why did you select this value?					
Respiratory I	1	2	3	4	5
Based on your above rating, why did you select this value?					
When taking the retake final for the course (for this project), I felt confident with my ability to answer a majority of the questions in [course listed below]:					
Digestive I	1	2	3	4	5
Based on your above rating, why did you select this value?					
Immunology/Hematology I	1	2	3	4	5
Based on your above rating, why did you select this value?					
Respiratory I	1	2	3	4	5
Based on your above rating, why did you select this value?					
General questions					
I learn best with case-based material.	1	2	3	4	5
Based on your above rating, why did you select this value?					
I learn best with discussion-based material.	1	2	3	4	5
Based on your above rating, why did you select this value?					
I learn best from lectures.	1	2	3	4	5
Based on your above rating, why did you select this value?					

Table 3: Comparative COPUS analysis

Student activity	RSC DSC IHSC			Instructor activity	RSC DSC IHSC		
	% time spent in 50-minute course				% time spent in 50-minute course		
Listening	8	52	100	Lecturing	44	36	96
Individual thinking/problem solving	8	0	0	Real-time writing	0	0	0
Discussing clicker questions	0	0	0	Following up on clicker questions or activity	36	32	0
Working in groups (worksheet)	0	0	0	Posing non-clicker questions	8	8	8

(Continued)

Student activity	RSC DSC IHSC			Instructor activity	RSC DSC IHSC		
	% time spent in 50-minute course				% time spent in 50-minute course		
Other group activity	16	32	0	Asking a clicker question	12	12	0
Answering questions posed by instructor	4	48	4	Answering student questions	12	0	8
Asking question	8	0	4	Moving through the class	0	0	0
Engaging in whole-class discussion	36	12	0	One-on-one discussions with students	0	0	0
Making a prediction about the outcome of a demonstration or experiment	0	0	0	Conducting a demonstration, experiment, etc.	0	0	0
Presenting	0	0	0	Administration	8	8	2
Test or quiz	0	0	0	Waiting	0	36	2
Waiting	0	0	0	Other	0	0	0
Other	0	0	0				

COPUS = Classroom Observation Protocol for Undergraduate STEM; RSC = Respiratory System course; DSC = Digestive System course; IHSC = Immunologic and Hematologic Systems course

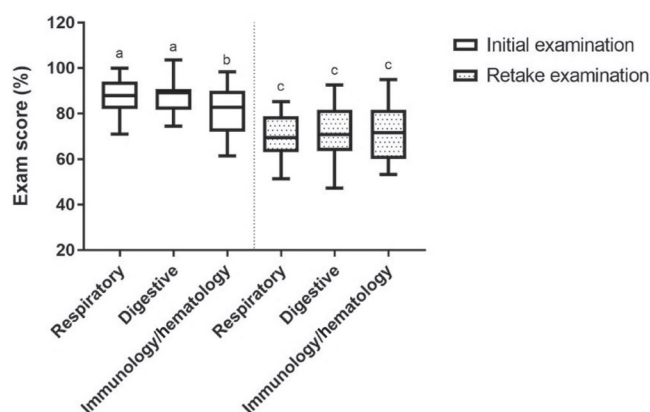


Figure 1: Box and whisker plots showing mean examination scores of the initial and retake examinations for the three courses evaluated
 Note: Different letters denote significant differences, with alpha < .05.

the average scores for the final examinations of the other two courses (Figure 1). Students performed better on initial examinations in courses that employed experiential instructional methods (e.g., small group discussions, clicker questions, and full group discussions). Mean scores on the initial examinations in RSC and DSC were 88.2% and 87.8%, respectively, and were significantly different from the mean score of the initial IHSC examination (81.9%, $p = .01$).

Mean retake examination scores were similar for all courses ($p = .76$) but significantly lower than the initial examination scores in each course ($p < .001$), with mean scores of 70.1%, 71.6%, and 71% for RSC, IHSC, and DSC, respectively (Figure 1).

Student Experience Survey—RSC

Students responded that they felt very confident in their ability to answer questions from the original finals and retake examinations for this course, which utilized experiential instruction methods (Figure 2). For RSC, 89% of students strongly agreed or somewhat agreed that they felt confident answering questions in the original final. For the same course, 74% of students strongly agreed or somewhat agreed that they felt confident answering questions in the retake final.

Student Experience Survey—IHSC

Approximately 41% of students strongly disagreed or somewhat disagreed that they felt confident in their ability to answer questions from the first examination; however, approximately 45% of students strongly agreed or somewhat agreed (Figure 3). For the same course, approximately 48% of students strongly agreed or somewhat agreed that they felt confident in their ability to answer questions from the retake examination, and 37% of the students strongly disagreed or somewhat disagreed in their ability to answer questions from the retake exam. These results show similar confidence among students from the first exam to the second.

Student Experience Survey—DSC

Students reported that they felt very confident in their ability to answer questions from the original finals and retake examinations for DSC (Figure 4). A total of 74% of students strongly agreed or somewhat agreed that they felt confident answering questions in the original final. For the same course, 59% of students strongly agreed or somewhat agreed that they felt confident answering questions in the retake final.

Student Experience Survey—Methods of Instruction

Students who somewhat agreed and strongly agreed that they learned best with case-based material, discussion-based material, or lecture-based material totaled 70.3%, 66.7%, and 74%, respectively (Figure 5). Students were able to select more than one answer, allowing for the overlap in these percentages.

Student Experience Survey—Thematic Analysis

Thematic analysis was conducted with the comments from students on the Likert questionnaire (Table 4). Responses were sorted based on common themes, and the frequency of occurrence was established. For the original final exam, students reported the most confidence with the courses using methods of experiential learning, DSC and RSC. This is seen with 11 of 18 responses reporting confidence for DSC with comments, including the following: “During the exam, I was confident in my ability to recall the information and succeed on the exam.” For RSC, 18 of 20 responses reported confidence with comments, including the following: “The ability to reflect on the material allowed

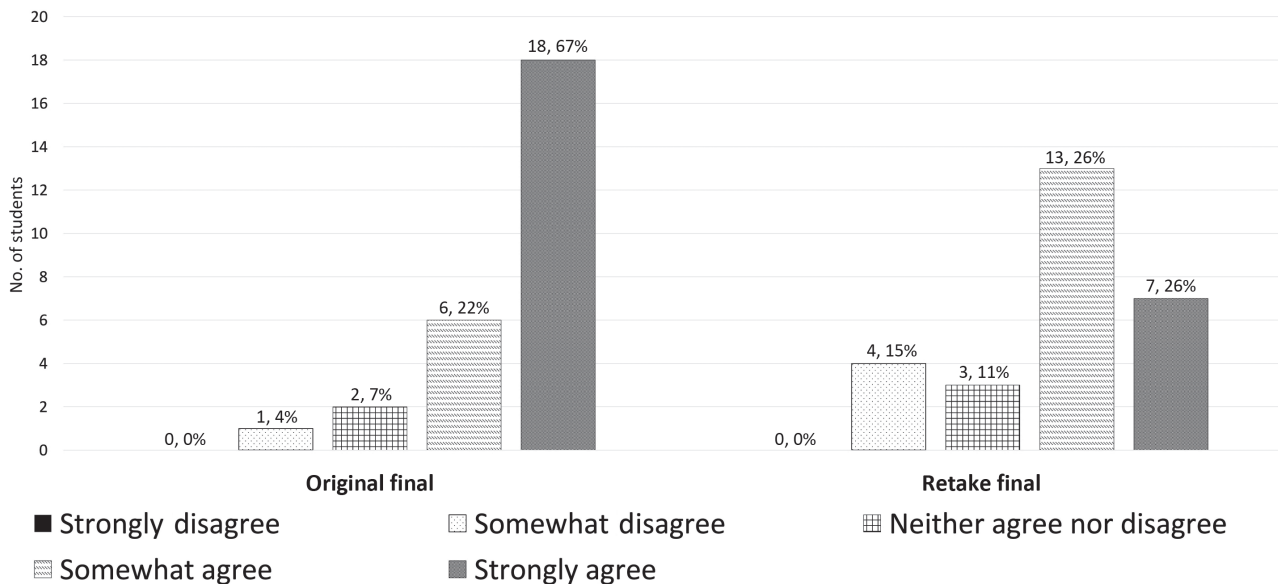


Figure 2: Survey results of student-perceived confidence in a course that primarily utilized discussion-based instruction, with student responses to “I felt confident in my ability to answer a majority of the questions for the Respiratory System course”

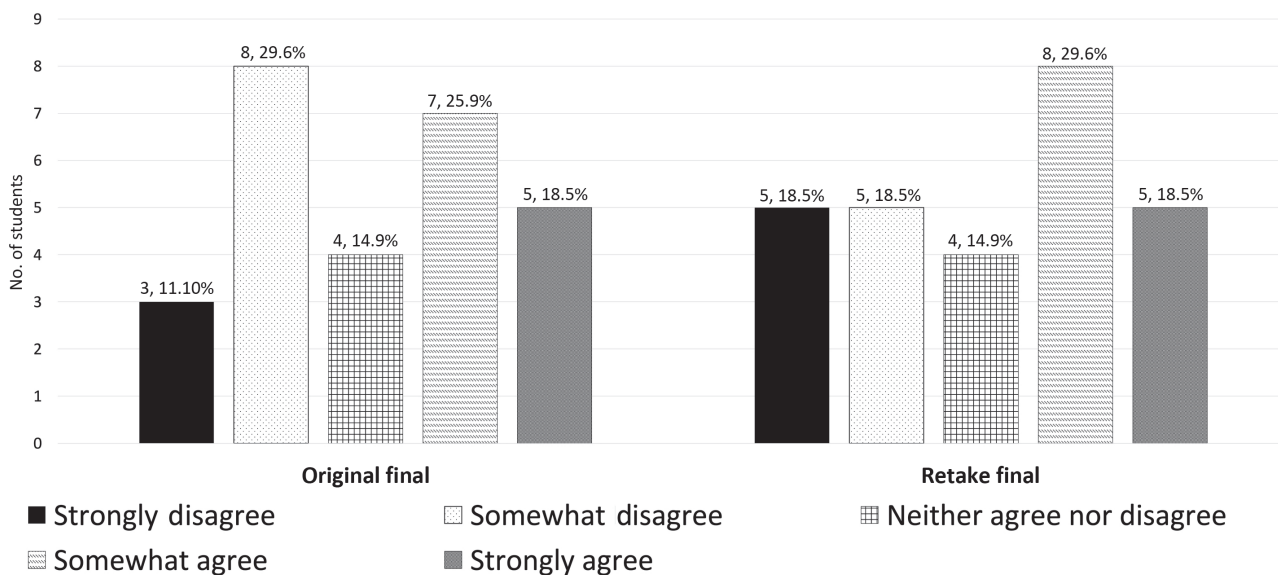


Figure 3: Survey results of student-perceived confidence in a course that primarily utilized lecture-based instruction, with student responses to “I felt confident in my ability to answer a majority of the questions for the Immunology and Hematology Systems course”

me to better understand the concepts.” Of 20 respondents, 13 reported a lack of confidence during the original final for IHSC. One student mentioned, “I had more difficulties understanding the materials for this class more than the others.”

For the retake final examination, students reported the most confidence with the RSC, and mixed confidence with the DSC and IHSC (Table 5). Of 16 responses for RSC, 11 reported confidence: “I felt very confident on the retake final. The course was presented in a way that allowed for active recall and testing, and this allowed me to really understand the material during the course and during the retake.” For the IHSC retake, 7 of 18 respondents reported confidence, and 10 of 18 reported lack of confidence. For the DSC retake, 9 of 21 reported confidence, and 11 of 21 reported lack of confidence.

For the question regarding modes of learning (Table 6), 5 of 18 students reported that a combination of methods would be most beneficial. Students noted that using lectures to learn information prior to any discussions or cases was most beneficial when it came to applying knowledge. The basis of knowledge provided in these lectures is what allowed them to participate and gain the most from the experiential methods. Of 18 students, 5 reported that their preparation was important for experiential learning methods. Comments included that they may not understand a case or discussion if they were not well prepared for it. Five students reported the most comfort with lectures, and three students reported that engagement through discussion or case-based learning helped them to understand, as it kept them involved.

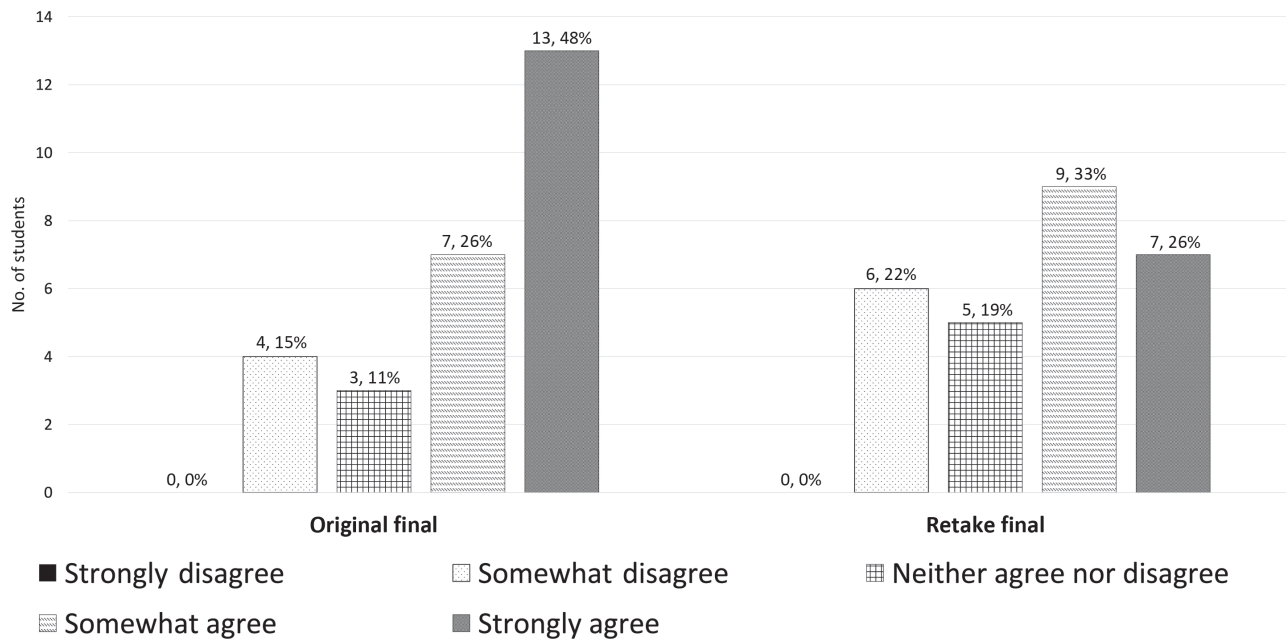


Figure 4: Survey results of student-perceived confidence in a course that primarily utilized case-based instruction, with student responses to “I felt confident in my ability to answer a majority of the questions for the Digestive System course”

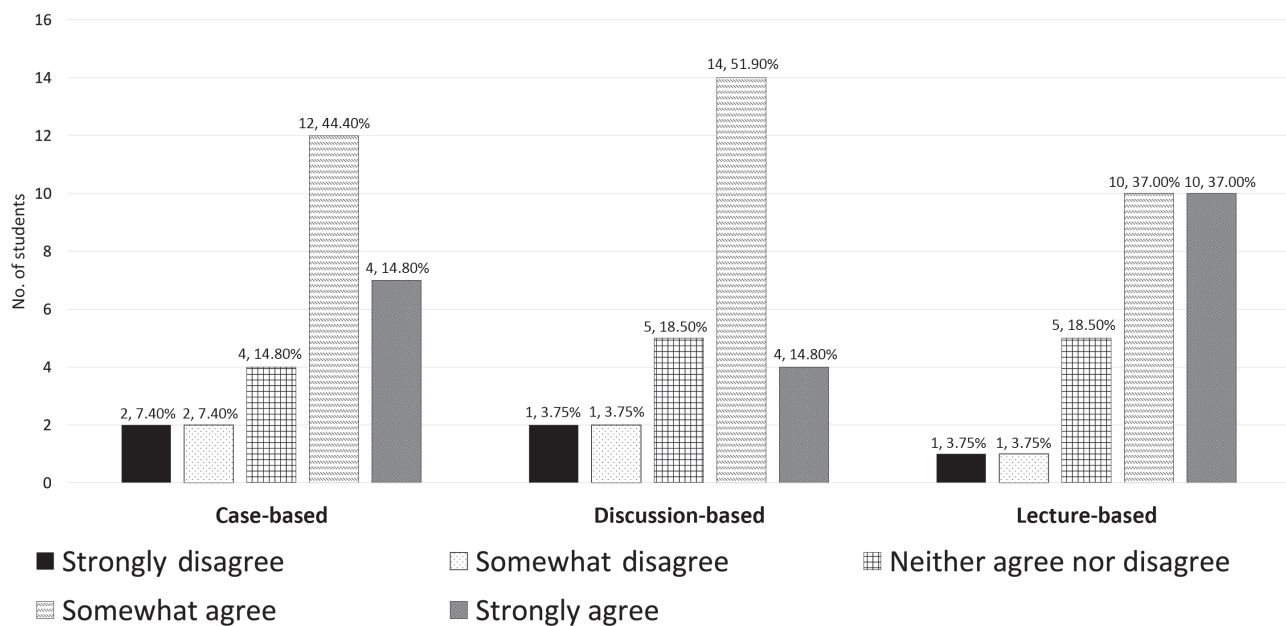


Figure 5: Student perspective on learning with different methods of instruction, with student responses to “I learn best with ...”

DISCUSSION

Based on the results of exam averages for each course, students initially performed better in the two courses that utilized experiential instruction methods (e.g., clicker questions and class discussions). However, performance was similar on retake examinations. While this may suggest that students had similar content retention across all methods, it is difficult to assess retention, in both the short and long term, in veterinary school. Instructors and students are often focused on the short-term outcomes (final exam grades) as a measure of successful learning. However, whether short-term outcomes can be used to predict long-term retention and performance in a practical

or clinical setting remains unclear and difficult to determine. Spaced retrieval is one method proposed to help convert short-term storage of information into long-term usable knowledge.¹¹ Subjects in the current study were recommended not to purposefully prepare for the retake examinations; however, this was not something the authors could track or enforce. With the assumption that the subjects did not purposefully prepare, they also did not have an opportunity for spaced retrieval. Thus, it is likely that our study demonstrated an expected use-it-or-lose-it phenomenon, with a decrease in short-term retention measures if not actively studied or applied in some manner before reassessment. Long-term retention is also difficult to

Table 4: Thematic analysis of Likert-style questionnaire regarding original final examination

Course	Theme of response	Frequency of occurrence (no. of students)	Sample participant narratives
DSC	Confidence with material and examination	1	“During the exam, I was confident in my ability to recall the information and succeed on the exam.” “I felt confident with the vast majority of the answers.”
	Lack of confidence with material and examination	5	“Some of the questions were not covered in class, and I had a hard time with this final.” “I did not feel confident taking this final the first time.”
	Lack of motivation in course	1	“I understand the material, but I am struggling with motivation this semester, so I was not fully prepared.”
	Too much material in course	1	“There was a lot of material, and I did not retain all of it.”
Total no. of responses		18	
IHSC	Confidence with material and examination	4	“I felt fairly confident in the material, but felt like finer details were lost.” “Despite this course seeming more difficult to me, by focusing on the learning objectives, I found the majority of test questions were easy to answer.”
	Lack of confidence with material and examination	13	“I had more difficulties understanding the materials for this class more than the others.” “I honestly didn’t think I retained any information from this course because I felt like I just had to regurgitate the information.”
	Lack of motivation in course	1	“I understand the material, but I am struggling with motivation this semester, so I was not fully prepared.”
	Too much material in course	2	“This was one of the most challenging finals I have taken. There was just so much information presented every day.”
Total no. of responses		20	
RSC	Confidence with material and examination	18	“This class was presented in a way that repetition allowed details to stick in my head.” “The ability to reflect on the material allowed me to better understand the concepts.”
	Lack of confidence with material and examination	2	“I struggle with feeling confident for any examinations.” “I struggled to get into the groove with the first half of the course, and it made it difficult to catch up at the end, so I felt less confident following the test.”
	Lack of motivation in course	0	–
	Too much material in course	0	–
Total no. of responses		20	

DSC = Digestive System course; IHSC = Immunologic and Hematologic Systems course; RSC = Respiratory System course

assess in a profession that is centered around lifelong learning, and the 5-week period used may actually reflect intermediate-term memory and retrieval.

Students who participated in the current study did so while immersed in another 3-week intensive course. These simultaneous activities may have made it difficult to focus on a repeat examination. Along with this, the retake examinations occurred over the weekend, which may have made it challenging for students who typically use that time for family, extracurricular activities, and general time off. Concurrent activities and extracurricular obligations, along with the fact that participation in this study was not incentivized, likely explains the small number of study participants. The relatively low number of subjects who volunteered to participate is a major limitation of the current study. Out of the total class of 115 students, only 27 participated fully in the retake examinations and survey questionnaires, which may have inadvertently introduced

some degree of selection bias. However, the information gleaned from this cross-section of students still provides valuable sentinel information and insight into general pre-clinical student learning experience and performance.

Participant survey responses revealed that students reported the most confidence taking the original final in the RSC and DSC courses, which were the courses that used more experiential learning methods. This is in line with previous research that shows enactment is superior for recall and testing compared with observation or lectures.¹² In the retake examinations, students expressed mixed confidence with both DSC and IHSC, which may be explained at least in part by the limited ability of students to metacognitively monitor their learning. Metacognitive monitoring has been defined as “evaluating the process of learning or current state of knowledge.”^{13(p.549)} Given the student responses that mentioned a lack of initial understanding, lack of motivation, and lack of confidence, long-term

Table 5: Thematic analysis of Likert-style questionnaire regarding retake final examination

Course	Theme of response	Frequency of occurrence (no. of students)	Sample participant narratives
DSC	Confidence with material and examination	9	"I had a blast during this course and all of the activities completed during it undoubtedly promoted deep understanding." "The questions were all related to understanding the learning objectives, and being able to apply that knowledge so I felt good."
	Lack of confidence with material and examination	11	"I didn't feel confident whatsoever, and I didn't remember most of the material." "By the time we took the retake exams, most of the information from the course was gone."
	Lack of motivation in course	1	"I understand the material, but I am struggling with motivation this semester, so I was not fully prepared."
	Too much material in course	0	–
Total no. of responses		21	
IHSC	Confidence with material and examination	7	"Because the material was harder, I feel like it stuck with me longer. I don't think I did great on the retake final, but I also recognized what the questions were asking and was able to understand most of the questions." "After the original final, I learned from my mistakes and had a better understanding of the concepts."
	Lack of confidence with material and examination	10	"I'd be lucky to have remembered at least half of the information from this class." "I didn't have a good enough understanding of the material for the exam, so I think more of the material got lost with me."
	Lack of motivation in course	1	"I understand the material, but I am struggling with motivation this semester, so I was not fully prepared."
	Too much material in course	0	–
Total no. of responses		18	
RSC	Confidence with material and examination	11	"I felt very confident on the retake final. The course was presented in a way that allowed for active recall and testing, and this allowed me to really understand the material during the course and during the retake." "I felt like I retained the majority of the materials and concepts from this course and when presented with the questions again I felt confident answering them."
	Lack of confidence with material and examination	4	"I forgot a lot of information since the class ended ... nothing seems to be truly sticking." "I really struggled with this retake and felt that I didn't remember most of what I had been taught."
	Lack of motivation in course	1	"I understand the material, but I am struggling with motivation this semester, so I was not fully prepared."
	Too much material in course	0	–
Total no. of responses		16	

DSC = Digestive System course; IHSC = Immunologic and Hematologic Systems course; RSC = Respiratory System course

retention may be bolstered by introducing students to meta-cognitive monitoring and methods to practice spaced retrieval to improve these issues.

Further thematic analysis was performed regarding students' perspectives on learning methods. Research in medical education suggests that students prefer multimodal learning styles,¹⁴ and this is corroborated by the results of the current study. Reasons for this are likely multifactorial, including students' past experiences, student diversity, and students' self-identified preferred learning styles and methods.

COPUS methodology has been used in undergraduate STEM courses to promote student-centered learning by instructors through use of problem-based education, clicker questions, and other activities, though its use has not yet been reported in the evaluation of medical education courses.¹⁵ While COPUS analysis was easily performed retrospectively on class recordings, the evaluation of one 50-minute class session may not be completely representative of teaching and learning activities during the entirety of each 3-week-long course. An additional limitation and challenge was the need to use video-recorded

Table 6: Thematic analysis of Likert-style questionnaire regarding methods of learning

Theme of response	Frequency of occurrence (no. of students)	Sample participant narratives
Combination of learning methods is beneficial	5	<p>"I feel like I personally am able to learn from any method of teaching, but the way I best learn material is to go through learning objectives posed as questions and find and present the answers through the readings or lecture prep. The case-based learning helps me to apply the concepts I familiarized myself with and solidifies that knowledge. Discussion is helpful as well, when I actively participate. I also really appreciate the recorded lectures for use in prep materials in going through learning objectives before class."</p> <p>"Lectures, especially those with written out points/presentations, are helpful for first learning the information, then some discussion helps me clarify. Finally, case studies really help me to understand how to apply it."</p>
Hands-on / discussion-based / case-based methods allow for engagement	3	<p>"I learn when I am engaged. I tune out of lectures which are generally not engaging."</p> <p>"It depends on how the lecture is presented, but I learn best when there is some kind of hands-on component or a component that lets me engage with the material."</p>
Lecture is most beneficial for learning	5	<p>"I tend to be more of an auditory learner, so lectures are the best for me."</p> <p>"Lectures have always worked best for me. Laying out the information and allowing me time to understand it has been the best way I learn."</p>
The most beneficial learning method is dependent on how prepared students were	5	<p>"I learn best when the information is presented in a consistent and clear manner. Some of our classes have had course packs, others have had study guides, and some have had neither. It is difficult adjusting to new formats every 2–3 weeks and I have a hard time switching up my learning style as often as we needed to."</p> <p>"I think the discussion-based material and the lectures that focused on the important points of the prep were the most helpful. The case-based depended on the placement of the cases. If it was later in the course it was fine but earlier in the course I didn't feel like I had enough information to answer the questions yet."</p>
Total no. of responses	18	

classes for analysis given COVID-19-related restrictions at our university. This precluded the observer's ability to obtain a full room scan of student activities, which may have contributed to an underestimation of active time spent in any given class.

The results of this study suggest that initial student exam performance was better in courses that utilized experiential instruction methods, but students performed similarly in all three course exams 5 weeks later. While these results may lead us to believe that the method of instruction affects short-term retention of material, this study did not account for other factors related to long- and short-term retention. The use of written exam performance could also be debated in regard to how it reflects true student learning and retention. However, given the common use of written exams, and without other objective values to compare, student exam grades were one of the factors compared across the three courses. In addition to the limitations mentioned above, inherent differences between courses with different topics, perceived difficulty, different assessment schedules, and different instructors could not be controlled for. In light of this, our results highlighting student perspectives and performance support the use of experiential learning methods, but future controlled studies are needed to better measure their short- and long-term effects on veterinary student learning.

NOTES

- a D2L, Kitchener, ON, Canada, <https://www.d2l.com>.
- b Examsoft, Dallas, TX, USA, <https://examsoft.com>.

- c GraphPad Prism 8.0, GraphPad Software Inc., San Diego, CA, USA, www.graphpad.com.
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