Evolution of a Course in Veterinary Clinical Pathology: The Application of Case-Based Writing Assignments to Focus on Skill Development and Facilitation of Learning

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ABSTRACT

Rationale for study – To encourage application and critical thinking, case-based writing assignments and grading rubrics were developed for use in a second-year core clinical pathology course. Objectives were to describe how this teaching technique was adapted to a large-class setting and how student perceptions of the learning experience guided modifications of this teaching technique over two presentations of the course and plans for a third presentation. Our goal was to enhance learning by encouraging application of course material to clinical situations and thereby improve students’ ability to organize and communicate information. Furthermore, we evaluated the influence of instructor feedback on the learning process.

Methods – With assistance from the University of Minnesota Center for Writing, assignments and grading rubrics were developed. Students completed course evaluation surveys designed to elicit feedback on the impact of the assignments.

Results – Increased learner confidence was reflected in larger self-reported increases in understanding of the material and ability to apply information and in increased feelings of preparedness for class and examinations. A large majority of students advocated the use of such assignments in the course in future years, and modifications to make grading and evaluation of assignments more efficient are underway.

Conclusions – Investment of faculty and student time in case-based writing assignments in the veterinary clinical pathology curriculum appears to increase student engagement with material and learner confidence. Future studies should address the impact of this type of assignment more specifically on clinical reasoning and communication skills and on long-term retention of material.

Key words: clinical pathology; writing; case-based; active learning

INTRODUCTION

Core veterinary clinical pathology courses are generally offered in the first two to three years of the curriculum. This phase of the curriculum is often fact-based, and student assessment is frequently in multiple-choice or short-answer format. Instructor input is typically categorical: student responses are either “right” or “wrong.” There is little opportunity for the student to express a rationale for the answer given, or for the instructor to guide the development of the student’s clinical reasoning process, until relatively late in the curriculum. Therefore, third- and fourth-year students are sometimes unprepared for the level of critical thought and communication skills required for success in the clinical environment.

To address these deficits, the American Veterinary Medical Association (AVMA) Council on Education (COE) has emphasized the need to incorporate several educational goals into the veterinary medical curriculum in addition to the acquisition of factual material.1–3 These goals include developing critical thinking and the ability to apply factual information in clinical settings; fostering the ability to find and organize information; encouraging small-group interactions working on cases; encouraging active learning with student investment in the process; and developing the ability to communicate effectively with clients and colleagues.1–3 Because clinical pathology is a transition course between the pre-clinical and the clinical sciences, and because it involves the interpretation of data in clinical settings, case-based assignments can be used to encourage the application of information and concepts to clinical situations. Asking students to interpret and apply course concepts enables cognitive activity beyond reiteration and comprehension, encouraging the sorts of higher-order critical and creative thinking (e.g., application, synthesis, and evaluation) that they will usefully employ in clinical settings.4 In a recent article describing educational strategies to promote clinical diagnostic reasoning, Bowen suggests encouraging the development of students’ skills in data acquisition and reporting, problem representation, generation of hypotheses, cognitive feedback, and contextual considerations.4 Our case-based writing assignments are specifically designed to incorporate all these elements.

The purpose of this article is to trace the development of a core second-year clinical pathology course over three years as we moved away from a traditional passive didactic format toward a student-centered approach that focuses on applying factual material in ways that contribute to the development of skills needed for success in veterinary medicine. The use of case-based writing assignments was an important tool in this process. An initial pilot study with
student volunteers, performed during the first presentation of the core clinical pathology course, revealed that the use of take-home case-based writing assignments increased learner confidence and that this benefit was enhanced when students received feedback on their cases. Based on student recommendations from the first presentation, take-home and in-class case-based writing assignments were a required component of the second presentation of the course. In a survey given after the second presentation of the course, students indicated that case-based writing assignments helped them keep up in class, reinforced factual material, aided with understanding and application of material, and helped them develop analytical skills. Importantly, grading and feedback were perceived to be fair and to encourage better student understanding of material. Students overwhelmingly recommended continuing use of such assignments in the clinical pathology core course. Student recommendations that we are using to modify the third presentation of the course include adding in-class discussion sessions to review the cases and distributing case write-up keys. The most consistently expressed negative aspect of this teaching technique, for both students and faculty, is the time required to prepare and assess these assignments. We were able to ameliorate these negatives with guidance and support from the University of Minnesota Center for Writing and the University of Minnesota Center for Teaching and Learning Services. We encourage educators who are considering the use of case-based writing assignments and other novel teaching methods to consult these online resources and other similar centers to help address the challenges of improving teaching methods in their curricula.

BACKGROUND

The design of the original course presentation was influenced by the five-year evolution of a similar course at Tufts University. The Tufts course was originally a heavily fact-based course. After reflection on the clinical practice experiences of the course director (Sharkey) and on the competencies eventually enumerated by the AVMA COE, more emphasis was placed on the application of factual information in problem-solving, critical thinking, and communication. Incorporation of in-class case discussions led to the addition of out-of-class case-based writing assignments that allowed the course director to assess more directly the progress of each student in the class and to coach the development of skills in data interpretation and communication on an individual basis. On course evaluations, Tufts students consistently indicated that the case-based writing assignments contributed to better understanding of material, encouraged the application of factual information in clinical settings, and improved critical thinking and retention of factual material, at least over the course of the semester, in preparation for the cumulative final examination. Anecdotal input from individual students suggested increased retention of material for applications in later phases of the curriculum. Each year at Tufts, teaching techniques were modified based on student input from informal class discussions and formal written surveys. Over time, it became clear that the presentation of factual material is a minor role of the educator in veterinary clinical pathology and that, in fact, the instructor is more valuable in providing context for factual information, in prioritizing information, and in supporting students as they develop their own skills in critical analysis of data and communication. In essence, the role of teacher was transformed to that of facilitator, as is appropriate for adult learners.

Planning for the first presentation of the clinical pathology course at the University of Minnesota (UM) took approximately one year. The faculty designed a course with the traditional curriculum of principles of statistics and instrumentation, hematology, coagulation, and clinical chemistry. The course format featured standard lectures and laboratory sessions with in-class case discussions, but there was interest in including case-based writing assignments, based on the course director’s previous experiences at Tufts. Course faculty recognized a need to optimize assignment design and grading to make the process more efficient for both instructors and students while retaining the educational benefits of the assignments. For this reason, the course director enrolled in applicable seminars sponsored by the UM Center for Writing. Particularly helpful were sessions on designing effective writing assignments and on responding to student writing as well as a week-long seminar intended to help instructors with developing courses that rely heavily on instruction with writing. With assistance from the Writing Center faculty, assignments and grading rubrics were developed for use in the clinical pathology course.

As part of a more formal assessment of the potential benefits of case-based writing assignments in veterinary clinical pathology, during the first year of the course we performed a small voluntary pilot study to assess the use of case-based writing assignments in a new curriculum. Because of the student time required to prepare assignments and the faculty time required to grade them, we divided students into three groups: one group had access to assignments but no requirement to turn them in; in the second, students were required to turn the assignments in but did not receive a grade or feedback; and in the third, the required write-ups were graded and commented on by faculty, although assignments did not contribute to the final course grade for any group. We hypothesized that making assignments required and grading them would create incentives for student participation and would improve outcomes such as preparedness for class and examinations.

Based on data from the pilot study supporting the value of required and graded assignments, required case-based writing assignments were incorporated in the second presentation of the course. Survey data were collected at the end of the semester on student perceptions of the assignments. The survey data were discussed with the class to formulate recommendations for modification of the course for the following (third) presentation. We anticipate that this process will continue for all subsequent years the course is taught as we strive to achieve a more student-centered approach to teaching that will facilitate the learning of the necessary factual information along with the development of competencies needed for success in veterinary medicine.

METHODOLOGY

First Course Presentation (Pilot Study)

Experimental Overview. Our study of the effect of take-home case-based writing assignments used a modified
problem-based learning strategy to evaluate the effect of cumulative case-based writing assignments in addressing the educational goals discussed above.10 We hypothesized that preparing multiple case-based writing assignments of increasing complexity over the course of the semester would improve learner outcomes and that a requirement to turn in assignments would increase participation. We anticipated that directed feedback on assignments would further enhance learning. “Learning” was assessed by final course grade, self-assessment of engagement with material, and degree of learner confidence.

Grades in the clinical pathology course were based on six short open-response quizzes and two predominantly multiple-choice examinations. Student volunteers (N = 64) were matched by cumulative grade-point average (GPA) and consented to random assignment to one of three groups. Members of each group received weekly case-based writing assignments of increasing complexity during the semester (see Appendix 1 for a sample assignment).

Group G was required to turn in assignments, which were graded on a scale of 0, V−, V, V+ based on pre-specified criteria that were made available to students prior to completing the assignments (see Appendix 2 for sample grading rubric). Assessment criteria included interpretation and synthesis of laboratory data, mechanistic explanations for abnormalities, and justification of differential diagnoses. Students received grades and directed comments on the case write-ups, including acknowledgement of areas of strength, correction of any misconceptions about course content, and suggestions for improving factual content, clinical reasoning, or clarity of expression. Assignments were consistently evaluated together by the course director and a clinical pathology resident. Members of Group W received the same assignments and were required to turn them in, but they did not receive a grade or directed comments. Group C received the assignments but was not required to turn them in.

Although Group G’s assignments were graded, these cases did not formally contribute to students’ final course marks. The Anderson-Darling test for normality indicated that the initial grade distributions were not Gaussian, so a non-parametric Kruskal-Wallis test was performed using the statistical program MiniTab.4 Cumulative GPAs at the beginning of the study were not significantly different between groups (medians for Groups G, C, and W were 3.48, 3.46, and 3.48 respectively, p < 0.05). Participants also completed a survey designed to characterize student participation and attitudes toward the assignments as a measure of engagement with material and learner confidence.

Designing the Case-Based Writing Assignments Assignments were based on real clinical cases presenting to the teaching hospital and included a short clinical history, a brief description of the physical examination findings, and increasing amounts of laboratory data based on what had been covered in lectures to date. Initial cases included hematology data only; later cases incorporated coagulation testing and clinical chemistry data. Abnormalities were confined to those analytes already discussed in class. To reinforce material and to emphasize integration of data, laboratory abnormalities in previously covered topics were included in cases focusing on new material. For example, all chemistry cases used at the end of the semester also had hematologic abnormalities to be interpreted along with the clinical chemistry data. Along with the assignments, all participating students received a detailed description of expectations, a grading scheme, and a sample case write-up. Support materials from the University of Minnesota Center for Writing were used to facilitate the design of assignments and grading rubrics.7-9

Survey Design and Distribution Paper surveys were distributed to the mailboxes of participating students and were turned in anonymously to a folder posted near the mailboxes. Completion of the survey was part of the study and, as such, was voluntary. The survey first asked students to identify their group assignment, a categorical estimate of hours spent on each assignment, and a categorical estimate of the number of assignments completed. The next section addressed students’ assessment of their own learning and confidence. This section included a series of statements to which students categorically responded “strongly agree,” “somewhat agree,” “do not know,” “somewhat disagree,” or “strongly disagree.” After each statement was a free-response comments section. The final section of the survey included four free-response questions.

Second Course Presentation Experimental Overview The Clinical Pathology course design was unchanged from the first year, except that case-based writing assignments were substituted for the quizzes. Grading rubrics consisted of a key with points allotted for information and concepts as well as for ability to communicate effectively. Students were given a point score along with directed comments, as described above. Graded assignments were returned within seven to 10 days. We also incorporated brief ungraded in-class writing assignments on clinical vignettes. Small sets of data with clinical histories were inserted intermittently into the lecture to reinforce particular sets of facts or concepts. Students were given five minutes to write down their thoughts before the whole class discussed the cases. The goal was to give all students a period for reflection on the case prior to discussion, hoping to improve the in-class case-discussion experience for students who might need more time to process the information. The mid-term and final examinations consisted of multiple-choice questions on factual material and case histories with data, as well as free-response case write-ups identical in format to the take-home assignments. Further information on materials used for the second study is available from the corresponding author on request.

Survey Design and Distribution A course-evaluation survey was prepared, with help from educational specialists at the UM Center for Teaching and Learning,6 to solicit student feedback regarding the course and the take-home and in-class case-based writing assignments. The paper survey was distributed and completed in class. The survey emphasized evaluating student perceptions of the value of the writing assignments, given the necessary investment of time, and solicited information about the value and fairness of a standardized, but somewhat subjective, system for grading.
Completing assignments helped me feel more prepared for class.

Completing the assignments helped me feel more prepared for examinations.

Table 1: First-year pilot study survey of student perceptions

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>Group C (N=12)</th>
<th>Group W (N=9)</th>
<th>Group G (N=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignments helped me understand and apply material presented in the course.</td>
<td>0 0 50% 25% 25%</td>
<td>0 0 12% 25% 38%</td>
<td>0 0 6% 25% 69%</td>
</tr>
<tr>
<td>Completing assignments helped me feel more prepared for class.</td>
<td>72% 10% 18% 0 0</td>
<td>0 12% 25% 25% 38%</td>
<td>0 0 21% 8% 71%</td>
</tr>
<tr>
<td>Completing the assignments helped me feel more prepared for examinations.</td>
<td>0 10% 54% 26% 10%</td>
<td>0 0 38% 24% 38%</td>
<td>0 0 21% 8% 71%</td>
</tr>
</tbody>
</table>

RESULTS

First Course Presentation (Pilot Study)
The final course grade was not significantly different between groups: Groups C, W, and G had identical median final course grades of 87% (Anderson-Darling normality test indicated non-parametric distribution, Kruskal-Wallis test p<0.05). Although the low number of final survey respondents (37 of 64, or 58%) did not allow statistical evaluation, group assignment appeared to influence ongoing participation in the study (Table 1) and student perception of the value of the case-based writing assignments. Students who were not required to turn in assignments (Group C) completed the fewest assignments and spent the least time on the assignments they did complete. Group W had slightly better participation rates, and students who received feedback on their assignments (Group G) completed more assignments and reported spending more time on assignments than did students in other groups. Group assignment also influenced survey participation rates, which were highest in Group G (76%) and lower in Groups W and C, which did not receive feedback on assignments (55% and 50%, respectively).

Students reported that assignments helped them understand and apply the material; students in Group G perceived the greatest effect and students in Group C the least (see Table 1). Students receiving feedback often made positive comments, such as “This was by far the best application we’ve had in school, learned so much!” Students who did not receive feedback commented that without a grade or comments, they never knew if they were “on the right track.”

The pattern was similar when students were asked if the assignments helped them feel prepared for class and examinations (see Table 1). Students in Group C disproportionately responded “I don’t know,” possibly because they often did not prepare the assignments. Many students in Group G supported the efficacy of the assignments as an aid to class preparedness with comments such as these:

After I slacked off on a few assignments I started feeling very lost in class.

Fortunately, I felt as if I did not have to study as much in the days before the exam because I had stayed on top of the material throughout. It also helped me better understand the material, not just cram it into my head. I hope to have better retention too.

Even a few students in Group C suggested, “I wish all classes had this type of application to help us with the material.”

Almost all students in Group G agreed or strongly agreed that feedback on assignments contributed to their understanding of the material (the remaining 7% said they did not know), and comments suggest that feedback also provided motivation to continue with this voluntary study. Representative student comments include the following:

Definitely, I think I wouldn’t have gotten as much out of the assignments without the feedback. Helped me realize the things I was confident with and what I needed to work on.

The comments were very helpful and motivated me to complete the work.

Survey responses indicated that the numbers of cases were generally appropriate and were of a reasonable level of difficulty (these data are not shown). Students were asked about factors limiting their ability to complete assignments, and time constraints were almost universally listed as a primary issue. Some students in Groups C and W cited lack of feedback as a cause of low motivation to complete assignments. When asked for free responses about factors motivating participation, students listed the ability to apply class material to clinically relevant situations (27%), increased perception of preparedness for exams and less “cramming” (27%), increased understanding of material (25%), enjoyment (11%), challenging but not impossible problems (8%), feedback (8%), and conditioning or obligation to complete tasks (8%). Eighty-nine percent of students completing the survey recommended that case-based writing assignments be incorporated into the formal curriculum in future years, although many qualified that all students should be given feedback and assignments should contribute to the final grade. The remaining 11% of students did not recommend the future use of these assignments, indicating concern about workload.
Second Course Presentation (Survey)
Of the 92 students in the class, 88 (95.6%) completed the survey. Fifty-six students strongly agreed that the case write-ups were a valuable part of the Clinical Pathology course, while 24 agreed, two disagreed, and two strongly disagreed. Forty-seven students reported spending more than five hours on average on each set of cases, while 26 students spent three to five hours on each and 13 students spent one to three hours. No one reported spending less than an hour, but there were two students who did not respond to this question. The majority of students (60/88) reported that the number of case write-ups assigned was “just right,” while 15 thought there were too many and 11 thought there were too few (two students did not respond to this question).

The rest of the survey data are summarized in Table 2. Students overwhelmingly agreed that the take-home case-based writing assignments were valuable in helping them keep up in class, reinforcing factual material, and aiding understanding and application of course material and that the assignments helped them learn data analysis and problem solving. Faculty effort invested in providing feedback on assignments was rewarded by students’ perception of better understanding of material, and grading was interpreted as appropriate and fair. Furthermore, the in-class writing assignments appear to have achieved the intended goals of reinforcing information and concepts prior to class discussion of cases or before moving to a new topic. The in-class assignments were less successful at encouraging students to participate in class discussion. Student comments indicated that some learners prefer to process information “on their own first,” that they require more time, “like overnight,” to consider material, and others said that they “always” or “never” participate in class discussions, regardless of format. Some students thought that “more individuals participate in class discussion than in other courses” and that this might have been because the pause in class prevented the “fastest” students from dominating the discussions.

The final survey item was an open-response question: “What are your suggestions for use of the assignments in future years?” More than 80% of the students recommended

### Table 2: Student perceptions as reported on second-year course evaluation (88/92 students responding)

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time spent working on the cases was justified by the amount I learned by doing them.</td>
<td>1</td>
<td>10</td>
<td>50</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>The assignments helped me keep up in class so I did less last-minute studying for exams.</td>
<td>3</td>
<td>14</td>
<td>41</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>The take-home writing assignments helped me learn the factual material.</td>
<td>1</td>
<td>5</td>
<td>56</td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td>The take-home writing assignments helped me understand the material.</td>
<td>1</td>
<td>1</td>
<td>53</td>
<td>33</td>
<td>0</td>
</tr>
<tr>
<td>The take-home writing assignments helped me apply the facts I learned in clinical situations.</td>
<td>1</td>
<td>0</td>
<td>51</td>
<td>35</td>
<td>1</td>
</tr>
<tr>
<td>The take-home writing assignments helped me learn data analysis and problem solving.</td>
<td>1</td>
<td>4</td>
<td>48</td>
<td>34</td>
<td>1</td>
</tr>
<tr>
<td>Feedback on writing assignments helped me understand the material better.</td>
<td>0</td>
<td>14</td>
<td>41</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Feedback on writing assignments helped me do a better job on the next set of cases.</td>
<td>1</td>
<td>18</td>
<td>40</td>
<td>24</td>
<td>5</td>
</tr>
<tr>
<td>Feedback on writing assignments helped me understand my grade on the assignments.</td>
<td>4</td>
<td>6</td>
<td>55</td>
<td>23</td>
<td>0</td>
</tr>
<tr>
<td>Grading of the assignments was appropriate and fair.</td>
<td>3</td>
<td>11</td>
<td>52</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>The in-class writing assignments were a valuable use of class time.</td>
<td>1</td>
<td>5</td>
<td>46</td>
<td>31</td>
<td>3</td>
</tr>
<tr>
<td>The in-class writing assignments helped reinforce information and concepts before moving on to another topic.</td>
<td>2</td>
<td>4</td>
<td>52</td>
<td>29</td>
<td>0</td>
</tr>
<tr>
<td>The in-class writing assignments gave me a chance to process information before group discussion proceeded.</td>
<td>3</td>
<td>7</td>
<td>57</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>The in-class writing assignments encouraged me to participate in class discussions.</td>
<td>3</td>
<td>26</td>
<td>41</td>
<td>15</td>
<td>3</td>
</tr>
</tbody>
</table>
continuing to use the assignments in some form. Consistent suggestions on the written surveys that were also reinforced in the class discussion of survey results included having smaller, more frequent assignments, with an hour of class time per week dedicated to reviewing the cases. Students commonly recommended that keys for the cases to be written up be distributed after cases are turned in. Small numbers of students commented that they felt preparation of cases was beneficial but would prefer to fill out a chart or to answer specific questions about cases. This was discussed in class as a way to resolve the issue of the time-consuming nature of the assignments, but most students indicated that the open-response format was more applicable to a "real-life" practice setting. As in the previous experience of using case-based writing assignments at Tufts, the most consistently reported negative aspect of this teaching technique was the time required to complete assignments.

DISCUSSION AND CONCLUSIONS

Based on our data, students over two presentations of the course perceived a significant learning benefit from the incorporation of case-based writing assignments in a second-year veterinary clinical pathology course. The benefits included increased self-reported understanding of material and increased preparedness for class and examinations, all of which increased learner confidence. The perceived benefits appeared to be enhanced when students received assessment and feedback on their work. This perception of increased preparation was not reflected in a significant difference in final course grades in the pilot study, although the skills developed by the case-based write-ups were not directly evaluated by the predominantly short-answer and multiple-choice assessments that were the basis for the final grades.

In the second presentation of the course, case-based write-ups were incorporated into the final examination to assess students’ ability to evaluate data and effectively communicate results more directly; since assignments were required for all students, however, comparisons were not possible. A strength of the pilot study was the initial randomization of students by cumulative GPA, which assured that there was no bias in group assignment. Because some students did not complete the final survey at the end of the semester, statistical analysis of student perceptions was not possible, and there may have been some bias in the self-selected population of students who did complete the survey. Another potential confounder was the fact that common misconceptions about course material were identified during evaluation of case write-ups submitted by study participants. These concepts were clarified for the whole class in subsequent lectures, so even students who were not in Group G received general feedback about problematic subject areas. This may have diminished any effect of individual feedback on final course grades. At the same time, this illustrates that carefully reading case-based assignments allowed instructors to improve the overall level of instruction by correcting gaps in student comprehension that might otherwise have gone unnoticed.

Based on data collected from students over two presentations of the course and on instructors’ reflections on the course and its goals, modifications for the 2007 Clinical Pathology course are now in progress. A weekly one-hour discussion section has been added, and keys for the written cases will be made available. The point system used to grade assignments in the second presentation of the course achieved the goal of consistency and fairness, but it was time consuming and left relatively little time for directed comments on student case write-ups. This year, we will use the faster 0, √, √, √+ system developed for the pilot study to allow time for more detailed and specific comments on student performance. We hope that this will also enable instructors to return graded assignments more quickly, since we received a few comments that a long interval (up to 10 days) between turning in assignments and receiving grades diminished the positive impact of the feedback. The mid-term and final examinations will continue to have both multiple-choice and case-write-up sections.

In an article titled “Teaching Our Students as We Want to Be Taught,” Osborne suggests that we clearly show students how to apply information by illustrating it with practical examples, provide timely opportunities for students to review and apply information already discussed, and respond to students’ ideas and mistakes constructively. In this study, we attempted to achieve these goals by using case-based writing assignments to give students the opportunity to review and apply information. By providing feedback, we responded constructively to students’ data and ideas in ways that enabled them to learn the material more effectively and to become more self-sufficient editors of their data interpretation and writing. Our data suggest that Osborne is correct in his prioritization of these strategies. Students reported increased learner confidence with the availability of assignments, which was further enhanced by instructor feedback.

As Canfield argues, the traditional lecture format predisposes students to a “superficial approach to learning” that undermines the larger didactic goals of the veterinary medical curriculum. In addition, a 1987 study conducted by Ruhl, Hughes, and Schloss found that when lecturing instructors paused for two minutes in intervals of approximately 15 minutes, students’ ability to recall information from the lecture increased substantially. When, during the pauses, students were asked to engage in a short task related to the lecture material (rewriting notes, answering questions, summarizing information), their ability to retain and think critically about lecture material increased even further. Our data on students’ perceptions of the in-class writing assignments corroborate this and support our continued use of this technique in the clinical pathology curriculum.

Instructors in colleges of veterinary medicine often balance multiple competing priorities, including clinical responsibilities, research programs, and heavy teaching loads. In our experience, many instructors cite time constraints as a primary reason for relying on standard methods of instruction and assessment, despite the deficiencies of these methods. Those who are able to invest the time are often not sure how to design appropriate assignments or how to grade these assignments efficiently and objectively. We found that with the support of the UM Center for Writing we were able to develop assignments with clearly
expressed objectives and expectations and pre-prepared grading rubrics that minimized the time spent evaluating student assignments. An initial investment of time in the preparation of instructions and grading rubrics pays off in subsequent years, because these resources are reused every year, with minor adaptations as the course evolves. This has allowed us to use a relatively time-intensive teaching method effectively in a large-group setting. Student feedback suggests that the additional investment by instructors was rewarded with an enhanced learning experience for students. The UM Center for Writing\(^5\) has many online resources and publicly accessible links that can support the efforts of anyone interested in using writing to diversify their teaching strategies. Likewise, the Center for Teaching and Learning\(^6\) has been a valuable partner in our efforts and supports online resources for interested instructors. As a result of time constraints and, occasionally, the physical separation of veterinary campuses from main campuses, veterinary faculty may not be aware of the resources available to them at their own universities.

Unfortunately, data are often lacking to support which teaching and learning strategies produce results and justify additional effort on the part of students and instructors in a veterinary medical curriculum. Our results indicate that case-based writing assignments were perceived by students to improve their learning experience during the semester and that the use of these assignments was overwhelmingly favored. Further studies are needed to determine whether students’ perceptions of enhanced learning over the semester culminate in better preparation for later course work. Even more important may be to assess how the use of case-based writing assignments may prepare students for their clinical year by increasing retention of factual material and enhanced problem-solving, critical thinking, and communication skills. We plan to work with faculty in medicine and surgery, the Office of Academic Affairs, and the UM Center for Teaching and Learning to begin to assess these important parameters. We look forward to reading about the efforts of others to evaluate alternative teaching strategies to broaden veterinary education.

NOTE


REFERENCES


AUTHOR INFORMATION

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APPENDIX 1: SAMPLE CASE-BASED WRITING ASSIGNMENT FOR PILOT STUDY IN THE FIRST PRESENTATION OF A CORE SECOND-YEAR CLINICAL PATHOLOGY COURSE

Platelets/Coagulation Case 3

**History:** “Tipper,” a 2 Y M Pug, presented with a history of being lethargic, very pale, and unwilling to move.

**Physical Exam:** Temp. – 99.9°F, Pulse – 148/min, Resp. – 70/min, mm – very pale, attitude – dull/latently

**PATHOLOGY COURSE**

**PRESENTATION OF A CORE SECOND-YEAR CLINICAL PATHOLOGY COURSE**
recumbent, ventrally decreased lung sounds are noted, no petechia or ecchymoses noted.

Radiology: Pleural effusion and air bronchograms compatible with intrapulmonary edema/hemorrhage. A tracheal wash revealed evidence of mild inflammation with resolving hemorrhage, including erythrophagocytic macrophages and iron pigment.

Laboratory Data:

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Units</th>
<th>Ref. Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV</td>
<td>15</td>
<td>%</td>
<td>37–55</td>
</tr>
<tr>
<td>TP</td>
<td>4.6</td>
<td>g/dL</td>
<td>6–7.5</td>
</tr>
<tr>
<td>PT</td>
<td>&gt;170</td>
<td>Seconds</td>
<td>6.2–7.7</td>
</tr>
<tr>
<td>PTT</td>
<td>62.2</td>
<td>Seconds</td>
<td>9.8–14.6</td>
</tr>
<tr>
<td>Fib</td>
<td>0.2</td>
<td>g/dL</td>
<td>0.2–0.4</td>
</tr>
<tr>
<td>Platelet</td>
<td>183</td>
<td>x 10^3/L</td>
<td>160–425</td>
</tr>
<tr>
<td>MPV</td>
<td>10.7</td>
<td>fl</td>
<td>6–11</td>
</tr>
<tr>
<td>PDW</td>
<td>17.8</td>
<td>10(GSD)</td>
<td>15.3–18.1</td>
</tr>
<tr>
<td>FDP</td>
<td>&lt;5</td>
<td>g/mL</td>
<td>&lt;5</td>
</tr>
</tbody>
</table>

Questions:

1. Describe the abnormalities in the laboratory data using appropriate medical terminology.

2. Using the clinical history and laboratory data, characterize the coagulopathy as a disorder or primary hemostasis or secondary hemostasis and support your interpretation.

3. What is a cause of the bleeding disorder that would be compatible with the clinical history and laboratory data? What other information or test results would you like to confirm your differential diagnosis?

APPENDIX 2: SAMPLE GRADING RUBRIC FOR CASE-BASED WRITING ASSIGNMENT FOR PILOT STUDY IN THE FIRST PRESENTATION OF A CORE SECOND-YEAR CLINICAL PATHOLOGY COURSE

General Evaluation Criteria for Platelet/Coagulation Cases: Case 3

1. A. Student correctly identifies laboratory data abnormalities. B. Student uses proper medical terminology. _____

2. A. Student correctly characterizes the coagulopathy and provides appropriate justification. B. Student communicates concepts and thought process clearly. _____

3. A. Student provides an appropriate differential diagnosis for the coagulopathy with supporting evidence. B. Student communicates concepts and thought process clearly. _____

(✓+: exceeds expectations, ✓: meets expectations, ✓−: meets minimal competency, 0: inadequate)