The Influence of Crib Sheets on Veterinary Students Exam Performance, Perceived Stress, and Retention of Subject Matter Knowledge

Amber H. Rice
University of Arizona
Tucson, AZ

Catherine M. Vogelweid
University of Missouri
Columbia, MO

Tracy Kitchel
The Ohio State University
Columbus, OH

Abstract

The purpose of this two-year longitudinal study was to examine the performance of veterinary students on exams utilizing crib sheets to determine their effects on exam performance, perceived exam stress, and retention of subject matter knowledge. Scores for individual exams where crib sheets were permitted were compared with exam scores where crib sheets were not permitted utilizing one-sample t-tests. One-sample t-tests were also utilized to determine the influence of crib sheets on subject matter knowledge retention for a cumulative exam. A questionnaire was distributed to capture students' perceptions about the value of crib sheets. Researchers found crib sheet use enhanced student exam performance, but did not improve retention of subject matter knowledge. Results from the questionnaire indicated students perceived crib sheet use as a way decrease exam anxiety and provide support during studying and testing. Disadvantages surfaced by students included that crib sheets could be used as a crutch and could decrease learning. It is recommended that instruction on strategies for use be implemented in any course using crib sheets. Overall, crib sheet use was perceived as positive by students and could be a viable way to combat high levels of anxiety and depression in veterinary students.

Introduction

The existing curriculum for the education of veterinary medical students delivers an enormous amount of subject matter in a four-year instructional time frame. As medical knowledge and societal expectations for veterinarians have increased, there has been an increase in the volume of information veterinary students are expected to learn (NAVMEC, 2011). In the College of Veterinary Medicine at the University of Missouri, didactic coursework in the second year of veterinary education is compressed into eight-week instructional periods. During the eight-week instructional period in which Virology is taught, students are also taking Parasitology, Bacteriology and Pathology courses. This intense eight-week instructional period has forced students into what they describe as a “binge and purge” mode of learning. They cram for one exam, take the exam, dump the information from their mind and then begin cramming for the next exam. Students have frequently verbalized to their instructor that the pressures to perform well academically on exams in this eight-week instructional period are significant sources of stress.

Exploring alternative testing strategies that might allay students’ concerns about their academic performance and decrease the levels of stress students experience when they are studying and taking exams is warranted because so many of today’s veterinary students are struggling to maintain positive mental health. Several recent studies have documented an unusually high prevalence of both anxiety and depression in veterinary students (Hafen et al., 2008; Reisbig et al., 2012; Siqueira Drake et al., 2012). Depression rates of surveyed veterinary students have been reported to be between 33% and 69% and these rates far exceed the rates of depres-
sion found in the general population and among other health professional students (Cardwell et al., 2013; Hafen et al., 2008; Siqueira Drake et al., 2012). These high rates of anxiety and depression have been linked, in part, to academic stressors that are embedded in the current educational system. These academic stressors include a challenging and intense curriculum, an ever-increasing amount of material to learn, unclear instructor expectations, a very heavy workload and very little time for relaxation or rest (Reisbig et al., 2012; Siqueira Drake et al., 2012). Some researchers have concluded that for many students, the current veterinary medical educational process acts as a chronic stressor, plunging susceptible students into chronic poor mental states like anxiety and depression (Hafen et al., 2008; Reisbig et al., 2012). These poor mental health states may persist as students leave school and enter the workforce; thus having long-term negative consequences for the individual (Hafen et al., 2008; Reisbig et al., 2012).

High levels of anxiety in veterinary students are often correlated with perceived high levels of academic stress (Reisbig et al., 2012). Primary academic stressors reported by veterinary students in previous studies were concerns about grades, exam performance and frustration with having insufficient time to learn the material (Gelberg and Gelberg, 2005; Reisbig et al., 2012). Veterinary students at the University of Missouri have verbalized similar concerns to their instructor. Veterinary students who are struggling with anxiety are even further disadvantaged as their coursework progresses because anxiety impedes learning. Anxious individuals lack the ability to concentrate and they also develop deficits in working memory (Hopko et al., 1998; Robinson et al., 2013). These memory deficits are accentuated when individuals are both anxious and depressed (Kizilbash et al., 2002). The negative effects of anxiety on exam performance are also prevalent in the literature. Students with high levels of anxiety perform more poorly on exams than students who are not anxious due to both impaired cognition and memory deficits (Cassady, 2004).

In an effort to reduce exam anxiety, crib sheets have been utilized in various educational disciplines (Butler and Crouch, 2011; Erbe, 2007; Gharib and Phillips, 2012; Gharib et al., 2012; Mathew, 2012). A crib sheet, also known as a cheat sheet, is a one-page sheet of notes created by a student when preparing for an exam that is then used as an aid when taking the exam (Raadt, 2012). The use of crib sheets has been shown to be strongly preferred by students over a closed-book testing format (Erbe, 2007; Larwin et al., 2012; Mathew, 2012). Crib sheets have also been proposed to facilitate learning, but the literature shows mixed results. Some studies have reported improved learning and performance on exams, while other studies report insignificant improvements in exam scores (Dickson and Miller, 2006; Erbe, 2007; Larwin, 2012; Larwin et al., 2012).

Proponents of crib sheets support their use for several reasons (Larwin, 2012; Larwin et al., 2012). First, crib sheets can increase learning because they can facilitate student engagement with the course materials. The preparation of the sheet encourages students to review, re-organize and clarify their thoughts about the subject matter. As students spend time preparing and revising their sheets, they are learning the material. Hand-written crib sheets have been found to be the most effective (Larwin, 2012). Another explanation for crib sheets improving exam performance relates to their effects on the emotional state of the student who is taking the exam. The use of a crib sheet provides the student with a positive perception of being able to remain in control during the exam. It thus provides a sense of emotional comfort and an expectancy of greater success (Raadt, 2012). Larwin et al. (2012) speculated the benefit of crib sheet use was not due to actual better mastery of the course subject matter; rather, it was due to the positive emotional effects of crib sheet use on the student. Detractors of crib sheet use claim they hamper learning because students merely write down information and then they do not study it sufficiently to learn it (Gharib et al., 2012; Larwin et al., 2012). Students can develop a dependency on the sheet and it may be used as a crutch instead of as a learning tool. Finally, Gharib and Phillips (2012) reported good students perform well on exams regardless of exam format. They recommended the use of crib sheet exams in situations where instructors wished to decrease student anxiety levels (Gharib and Phillips, 2012).

Previous studies of crib sheet use in education have applied their use across different scientific disciplines, ranging from psychology to applied mathematics and statistics. To date, there has been only one published study evaluating learning outcomes in veterinary students when crib sheet use is permitted, but it was limited to one year (Vogelweid et al., 2014). It was recommended future studies examine the long-term effects of exam aids to determine subject matter knowledge retention with use of crib sheets (Vogelweid et al., 2014). The goals of this study were to examine the performance of veterinary students on exams when crib sheet use was permitted to determine the effects of crib sheets use on the perceived amount of exam-induced stress, and to evaluate the effects of crib sheet use on retention of subject matter knowledge.

Materials and Methods

Participants

Data were collected over two years from second-year veterinary students enrolled in a Virology course in 2012 and 2013. All second-year veterinary students were informed about the study and were eligible to participate. During the first week of class, one of the co-investigators met with the students to explain the objectives of the study and voluntary participation was sought. Students electing to participate in the study were informed of the data analyses that would be conducted and that they would be asked to complete an opinion survey after the course. The course instructor remained blinded.
to the identities of participating students until after the submission of the final course grades. Students who elected to participate in the study signed consent forms. The study was approved by the Campus Institutional Review Board of the University of Missouri.

To establish that students in these two classes were essentially equivalent academically, entering GPA and GRE scores data were compared. Students participating in the course in 2012 had an average GPA of 3.77 and an average GRE of 1122 when they were admitted to veterinary school. Enrolled students in 2013 had an average GPA of 3.72 and average GRE of 1125 when they were admitted to veterinary school. In 2012, 111 of 115 enrolled students participated in the study. In 2013, 110 of 112 enrolled students participated in the study.

Method

The Virology course is a didactic course taught over an eight-week instructional period and consisted of five lectures per week. There were five non-cumulative exams given over the eight-week instructional period and they were spaced at approximately equal intervals. A subject matter knowledge retention exam (exam 6, see paragraph below) was given in week eight. All exams consisted of multiple choice questions given using a computerized testing format. For exams where the use of the crib sheet was permitted, the crib sheet was one side of one-half of an 8.5” x 11.5” sheet of paper on which students could hand-write any information they chose to help them with recall of information during the exam. Students were not given any prior instruction on how to prepare or use a crib sheet.

This study was conducted over two years (2012 and 2013) utilizing a parallel design. For both years, the lecture schedules, exam schedules and exam questions were matched. The only change in the course between Year 1 (2012) and Year 2 (2013) was permitting students in Year 1 to use crib sheets for exams 1, 3 and 5; while students in Year 2 were permitted to use crib sheets for exams 2 and 4. By alternating the use of the crib sheet on exams given over two years, direct comparisons of performance could be made. In both years, exam 6 was a retention exam given during the final week of the instructional period. The memory retention exam was comprised of 20 multiple-choice questions from previous exams 1-4; 10 questions from exams in which a crib sheet had been used and 10 questions from exams in which no crib sheet had been used. Questions for the memory retention exam were selected in Year 1 from questions most students had previously answered correctly on exams 1-4.

Students’ opinions about crib sheet usage were obtained via a questionnaire students completed after the conclusion of the Virology course. The questionnaire consisted of Likert-scale questions about the perceived value and usefulness of the crib sheet, questions about the effects of crib sheet preparation on exam preparation time, questions about student’s perceived level of stress during Virology and essay questions that asked students to summarize the advantages and disadvantages of crib sheet use in Virology. The number of participating students who completed the survey was 107 in Year 1 and 94 in Year 2.

Analytic Strategy

The study compared the scores for individual exams in which crib sheet use was permitted with the score for that same exam when crib sheet use was not permitted. For example, the scores in years 1 and 2 were compared for Exam 1. This comparison was done using one-sample t-tests. One-sample t-tests were also used to determine the influence of crib sheets on subject matter knowledge retention scores (exam 6). The mean class scores for each exam from Year 1 was tested against the participants' scores for Year 2. For all t-tests, differences were considered significant if \( p < 0.05 \).

Questionnaire data regarding students’ perceptions of crib sheet use were analyzed by calculating the mean and standard deviation for the Likert-scale questions. Students were also asked to report their perceived stress during the Virology course using Likert-scale questions and this data was analyzed utilizing frequencies. For the essay question data, a summary of the students’ opinions about the major advantages and disadvantages of crib sheet use was obtained as follows. One of the investigators read each student essay response and categorized the students' responses. To establish reliability, a co-investigator repeated this process and found similar categories. The major perceived advantages of crib sheet use stated by the students could be itemized into the following subcategories determined by a combination of the two investigators analysis of the essay question data: 1) Crib sheet use decreased stress or test anxiety; 2) Crib sheet use increased engagement with the subject matter and increased learning; and 3) Crib sheet use provided emotional comfort or a sense of security when taking the exam. The major perceived disadvantages of crib sheet use stated by the students could be itemized into the following subcategories: 1) Dependency on the crib sheet decreased student learning; and 2) Use of the crib sheet slowed test taking speed. Some students listed multiple advantages or disadvantages of crib sheet use in their responses, and each advantage or disadvantage stated by a student was placed into the appropriate subcategory and counted. Finally, the categorized responses were summed, and converted to a percentage of the total number of responses.

Results and Discussion

Exam Scores and Comparison of Crib Sheet Use on Exam Scores (Exams 1-5)

Tables 1 and 2 display the exam score means and standard deviations for 2012 and 2013, respectively. Data from exam 4 in Year 1 were excluded from the analysis due to a technical error that occurred during the administration of the computerized examination that might have compromised the validity of the exam.
Crib Sheet Use and Subject Matter Knowledge Retention

For retention exam 6, there was a statistically significant difference between exam 6 questions 1-10 and exam 6 questions 11-20 in 2012 and 2013.

- Exam 6 questions 1-10 2013 (no crib) was statistically significantly lower than exam 6 questions 1-10 2012 (crib), [t (111) = -4.60, p=0.00].
- Exam 6 questions 11-20 2013 (crib) was statistically significantly lower than exam 6 questions 11-20 (no crib), [t (105) = -1.39, p=0.00].

Crib Sheet Use and Students’ Perceptions

Responses to the Likert scale questions regarding students’ perceptions of crib sheet use are shown in Table 5 for 2013. For the 2013 questionnaire, an additional question was added: “During the weeks where multiple exams were scheduled, I found the crib sheet helpful in preparing for and taking my Virology exam.” This question was included in year two after the instructor received multiple comments in their course evaluations regarding the helpfulness of the crib sheets during periods of the semester with multiple exams. The 2012 data regarding students’ perceptions were similar to 2013, (see previous findings reported in Vogelweid et al., 2014).

Responses to the Likert scale questions regarding students’ perceptions of their stress levels during the Virology course were reported in frequencies. Greater than 75% of the veterinary students that participated in this study experienced at least a moderate level of stress during the Virology course. Students in Year 1 reported the following stress levels: 78 students experienced moderate stress, 6 students experienced high stress and 1 student experienced very high stress. In Year 2, 60 students experienced moderate stress, 24 students experienced high stress and 3 students experienced very high stress.

In essay responses, students stated the advantages of crib sheet use (250 total response statements) outnumbered the disadvantages (186 total response statements). Students stated the primary advantage of crib sheet use was it improved their level of engagement with the subject matter and it facilitated their learning (44.4% of responses). A second advantage of crib sheet use was it reduced the level of anxiety or stress associated with taking the exam (38.8% of respondents). A smaller number of students derived emotional comfort or support from the use of the crib sheet. Students stated the major disadvantages of using a crib sheet were its use either decreased their learning
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(37% of respondents) or it made it easier to neglect studying (35% of respondents). Fewer students stated using the crib sheet was disadvantageous because it slowed their test taking speed (9% of respondents) or the time spent preparing the sheet took time away from more productive studying (10% of respondents). A few students stated the exam questions seemed harder when crib sheet use was permitted. Only one student thought the crib sheet gave a false sense of security and one student stated the act of preparing the sheet was actually stressful. Responses to the survey essay questions are summarized in Tables 6 and 7.

Discussion

Crib sheet use by veterinary students enhanced exam performance and permitted students to score higher on exams. This mirrors findings from various studies documenting the positive effects of crib sheets on exam performance (Dickson and Miller, 2006; Erbe, 2007; Raadt, 2012). This effect was significant for exams 1, 2 and 3. The exception was exam 5 in 2013 (no crib) which was statistically significantly higher than exam 5 in 2012 (crib). This phenomenon could have occurred for a variety of reasons. First, as the Virology course progressed, students could have learned how to study more effectively and became more comfortable with the course instructor, course expectations, and exam structure. Second, due to the use of crib sheets in the Virology course for some exams, students may have experienced decreased overall stress allowing them to study and retain more information for exam 5.

While the use of crib sheets enhanced the general exam performance of the students, it did not have the desired outcome on subject matter knowledge retention as evidenced by the comparison of questions from retention exam 6 for 2012 and 2013. It is possible the purpose of crib sheets may need to be focused on recall performance and stress relief as opposed to longer-term subject matter knowledge retention. It is also possible relying on the crib sheet for some information could limit subject matter knowledge retention for exam 6. It is recommended additional studies be conducted to investigate the long-term influence of crib sheets on subject matter knowledge retention to rule out any negative effects of crib sheet use. Other long-term measures and approaches should also be considered as this study only spanned the course of two years.

Overall, the students preferred to use crib sheets in their Virology course. Student responses to the Likert-scale questions were similar from 2012 to 2013 (see Vogelweid et al., 2014). For both years, students indicated they agreed their stress levels were lower during exams allowing the crib sheet, the crib sheet was helpful in reinforcing and remembering materials, and they would prefer to use the crib sheet for all exams in Virology and for other courses. In 2012, student responses indicated they agreed the crib sheet helped them to retain the course information longer. However, in 2013, student responses regarding the role of crib sheets in retaining course information did not fall into the real limits of agree. Perhaps, students are using the crib sheet as a crutch and not truly learning the course material. It is recommended future studies investigate how the students are using the crib sheets to identify possible issues and solutions. Possibly the issue is not the crib sheet itself, but how it is being developed and utilized by the students.

Students’ perceptions about the advantages of crib sheet use mirrored their responses to the Likert-scale questions. The biggest advantage for students was the use of crib sheets decreased their perceived overall stress. Stress levels reported by veterinary students in this study reflect those reported by other institutions (Hafen et al., 2008; Siqueira Drake et al., 2012). The perceived reduction of stress by the students while using the crib sheet is important in light of the links between academic stress and anxiety and depression (Reisbig et al., 2012; Siqueira Drake et al., 2012). Previous studies have also found crib sheet use reduces anxiety (Butler and Crouch, 2011; Erbe, 2007; Gharib and Phillips, 2012; Gharib et al., 2012; Mathew, 2012) and recommended the use of crib sheets (Gharib and Phillips, 2012). It is recommended crib sheet use continue to be implemented in this program and other veterinary programs as way to reduce potentially harmful stress in students.

Related to decreasing stress and anxiety, another student advantage of the crib sheet was it provided emotional comfort and support. This could also contribute to the reduction in stress experienced by some students. This phenomena of the crib sheet as a “security blanket” is discussed in previous literature (Larwin et al., 2012) and while this may be the case for some of the students in this study, it still contributed to a perceived reduction in stress. Again, with the high levels of anxiety and depression linked to veterinary students (Cardwell et al., 2013; Hafen et al., 2008; Siqueira Drake et al., 2012), it is recommended crib sheets be utilized to help alleviate some of the stress and pressure associated with veterinary programs, even if their use is more focused.
on student comfort than a true knowledge development or reinforcement tool.

Students also reported some disadvantages of crib sheet use. The most frequently reported disadvantages were dependency on the crib sheet decreased learning and the crib sheet was utilized as a crutch to neglect studying. Similarly, other researchers have described students utilizing crib sheets as a crutch and developing a dependency on the tool (Gharib et al., 2012; Larwin et al., 2012). These concerns could be alleviated with proper training on the use of crib sheets as a tool. Like any other teaching tool the intentionality of crib sheets must be clear in order for it to be effective. Raadt (2012) recommended students do the following in order to utilize crib sheets effectively: match the ordering of the course subject matter to the crib sheet content, record abstract representations of concepts as opposed to specific examples, and avoid recording answers of past examinations in hopes it will appear on the exam. By explicitly describing strategies for optimally using a crib sheet, its effectiveness could be strengthened. It is recommended educators of veterinary medicine describe strategies for use when introducing a crib sheet to their curriculum. Future research based on the results of this study could include expanding the use of crib sheets to outside of the Virology class. The students expressed they would like to use crib sheets in their other veterinary courses both through the questionnaire and verbal comments to the instructor. Virology is only one of four classes taught to students during the eight-week instructional period, so if the goal of crib sheet use is to reduce stress and enhance exam scores it could be beneficial to implement this tool in other courses. Another avenue for future research could be to provide explicit instruction on how to optimally utilize crib sheets as recommended by Raadt (2012) and then investigate students’ perceptions on crib sheet use. Finally, it is important to replicate this study at other institutions with veterinary programs to see if similar results are found.

Summary

Based upon the findings of this study it can be concluded the use of crib sheets in veterinary medicine education may enhance exam performance. Students viewed crib sheets as a way to decrease their overall exam stress and desired to continue to use crib sheets in future courses. Some negative effects of crib sheets included students viewing them as a crutch to neglect studying and no connection was found between crib sheets and retention of material. It is recommended future studies explore specific strategies for crib sheet use to result in the optimum combination of stress reduction without dependency on the tool. Research on the use of crib sheets in other veterinary medicine courses is needed to see if similar results are found.

Literature Cited


NAVMEC Board of Directors. 2001. Roadmap for veterinary medical education in the 21st century: Respon-
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