RELATIONSHIP BETWEEN ATTENDANCE, ACADEMIC PERFORMANCE, AND LECTURE-CAPTURE AMONG VETERINARY STUDENTS

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Abstract: This study examines the relationship between attendance, academic performance, and lecture-capture use among veterinary students. Student attendance in four courses was documented over an entire semester by use of time-lapse photography. Academic performance, as determined by the final percentage grade in each of the four core courses as well as a comprehensive grade in the semester was obtained. Lastly, the number of times a student viewed a recorded lecture-capture in each course was monitored. These outcomes were assessed by Pearson correlation. Students were divided into four groups for attendance based on quartile. Grade and number of recorded lecture views for students in the lowest and highest quartile were then compared. Significant differences in both factors were found when comparing students with lowest and highest attendance. Students with the highest attendance outperformed those with the lowest attendance in all comprehensive grade and all but one course. Students with the lowest attendance viewed more recorded lectures overall and in all but one course. The results are discussed within the framework of self-regulated learning theory.

TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

Table Page

CHAPTER I

INTRODUCTION

Background of the Problem

Recording of lectures and publishing those lectures to an online classroom management software platform is becoming increasingly common practice in higher education and professional programs (Bollmeier, Wenger, & Forinash, 2010; Danielson, Preast, Bender, & Hassall, 2014; Leadbeater, Shuttleworth, Couperthwaite, & Nightingale, 2013; Marchand, Pearson, & Albon, 2014; Maynor, Barrickman, Stamatakis, & Elliott, 2013). Lecture-capture differs from videos utilized in massive open online courses (MOOCs) in that the latter are scripted and generally have higher production value whereas lecture-capture is simply the recording of a generally unscripted, face-to-face lecture which is then made available to students online (Lokuge Dona, Gregory, & Pechenkina, 2016). This advent in technology allows for increased flexibility for student and educator, allows for students to review previously discussed material, view missed material, and enhance overall learning (Bollmeier et al., 2010; Gorissen, Bruggen, & Jochems, 2012; Leadbeater et al., 2013; Marchand et al., 2014; Maynor et al., 2013). While students have embraced this technology, educators are more reluctant to do so, citing concerns for negative impact on student attendance and concurrent negative impact on student learning and performance (Kwiatkowski & Demirbilek, 2016; Marchand et al., 2014; Maynor et al., 2013; Toppin, 2011).

Statement of the Problem

Prior studies have evaluated the use of lecture-capture in the medical and pharmacy professional curriculum and found varying impact on student attendance and performance (Billings-Gagliardi & Mazor, 2007; Bollmeier et al., 2010; Cardall, Krupat, & Ulrich, 2008; Marchand et al., 2014; Maynor et al., 2013). Despite being commonly utilized in the veterinary curriculum, there are currently no studies that evaluate the relationship between lecture-capture, performance, and attendance in the professional veterinary curriculum.

Purpose of the Study

The purpose of this study was to evaluate the relationships between students' class attendance, performance, and viewing of capture-recorded lectures at a college of veterinary medicine. The variables measured included individual student attendance in all core courses over the course of a semester, performance as determined by final percentage grade in all core courses in a semester, and individual students' viewing habits of capture-recorded lectures in a semester.

Significance of the Study

As mentioned, there are currently no studies evaluating the relationship between lecture-capture, attendance, and performance in the veterinary curriculum. There is a concern that the use of lecture-capture may result in a decrease in class attendance (Kwiatkowski & Demirbilek, 2016; Marchand et al., 2014; Maynor et al., 2013; Toppin, 2011). Absenteeism has been previously demonstrated to correlate with lower grades (Devadoss & Foltz, 1996; Moore, 2003; Romer, 1993; Stanca, 2006). Additionally, prior work has demonstrated that high-achieving undergraduate students view capture-recorded lectures less often than low-achieving undergraduate students do (Owston, Lupshenyuk, & Wideman, 2011). The relationship between veterinary students' viewing of capture-recorded lectures and performance has limited evaluation. This study helps to add to this small body of literature.

Definition of Terms

- Lecture-capture – is defined by EDUCAUSE as ". . . an umbrella term describing any technology that allows instructors to record what happens in their classroom and make it available digitally" (EDUCAUSE, 2008, p. 1).
- Active-learning – a method of teaching that utilizes learning activities to increase engagement in students and is thought to promote deeper understanding of the material. In contrast, passive learning occurs when information is merely provided to student, as in a traditionally thought of lecture. "Active learning recognized that individuals have to engage with the content and with others, unveil prior ides, make connections between ideas, and construct new knowledge from experiences." (Ueckert & Gess-Newsome, 2008, p. 48)
- Self-regulated learning – the process of controlling one's learning through metacognitive, motivational, and behavioral regulation (Zimmerman, 1990).
- Attendance – for the purpose of this paper, attendance will refer to a student's physical presence in a live lecture
- Viewing lecture(s) – for the purpose of this paper, "viewing lecture(s)" will refer to the act of viewing a capture-recorded lecture. It may also be referred to as "viewing".
- Performance – for the purpose of this study, performance will refer to individual student's grade. A final course grade was determined for each of the four core courses in the semester as well as an average grade for the semester by combining the 4 core courses.

Overview

Chapter 2 provides a review of the literature as it pertains to student attendance and academic performance, students' and faculty perception of lecture-capture technology, how

students utilize lecture-capture, and the potential impact of lecture-capture on students' attendance and performance. A theoretical framework in which to frame this study will also be discussed. Chapter 3 will describe the study design and methods as well as expand on the research questions. Chapter 4 will provide data analysis describing the relationships between the variables of the study. Chapter 5 will discuss the findings, elaborate on possible implications, and discuss limitations of the study as well as possible future directions.

CHAPTER II

REVIEW OF THE LITERATURE

Initially the theoretical framework will be discussed followed by a review of the literature which will summarize prior published works relevant to the subject of lecture-capture in higher education, particularly within the context of a professional curriculum. Initially the relationship between student attendance and academic performance will be discussed. This will be followed by an overview of student and faculty perception of lecture-capture, highlighting the difference between these two populations. Subsequent information will then discuss how students utilize lecture-capture and lastly there will be a summary of the impact of lecture-capture on attendance and performance, focusing on students in a professional curriculum.

Theoretical Framework

Self-Regulated Learning Theory. Numerous theories have been described to understand the process of learning and motivation to learn. Social cognitive theory describes the relationship between the individual, the environment, and the behavior as triadic reciprocality, or having an interconnected relationship (Zimmerman, 1989). The influence of these spheres is not necessarily equivocal and can change depending on the context. The extent to which one understands and can control these components is the core of self-regulated learning (Pintrich, 2004). Self-regulated learners utilize

an approach of goal setting, monitor and evaluate their progress towards goal completion, and adjust their approach based on these data (Pintrich, 2004; Pintrich & Degroot, 1990). Additionally, self-regulated learners understand their own learning outcomes and are able to control aspects of their learning through alteration or manipulation of their cognition, motivational, and behaviors (Broadbent & Poon, 2015; Pintrich & Degroot, 1990; Zimmerman, 1990).

Zimmerman (1990) describes 14 strategies utilized by self-regulated learners "self-evaluation, organization and transformation, goal setting and planning, information seeking, record keeping, self-monitoring, environmental structuring, giving self-consequences, rehearsing and memorizing, seeking social assistance (peers, teachers, or other adults), and reviewing (notes, books, or tests)" (p. 7). As it may pertain to the utilization of lecture-capture, it is theorized that self-regulated learners will be able to successfully incorporate the technology as another tool to reach their individual learning goals. Strategic use of lecture-cpature is in alignment with prior reports of how similar populations, namely medical, pharmacy, and dental students, utilize the technology (Bollmeier et al., 2010; Cardall et al., 2008; Marchand et al., 2014). Lecture-capture provides self-regulated learners with additional control over their environment by allowing opportunities for them to receive lecture material repeatedly, at their own pace, and even at their preferred time of day. As an example, it is well established that there are individual differences in circadian rhythms and preferences for time to work or learn and how this may affect an individual's learning (Preckel et al., 2013; Randler & Frech, 2009). Most professional programs, including veterinary programs, are designed such that courses are only offered in the mornings. Prior studies have demonstrated a disadvantage to students whose natural circadian rhythms have a preference for eveningness (Preckel et al., 2013; Randler & Frech, 2009). Lecture-capture affords students with a preference for eveningness to better regulate their own learning.

Literature Review

Historical Relationship Between Student Attendance and Performance. Prior works have demonstrated a relationship between attendance and academic performance. Romer (1993) examined the relationship between attendance and performance and found that students who attended all lectures had an average final course grade of B+ compared to students who attended only 25% of lectures, who had an average grade of C-. However, given this study only evaluated attendance for six class sessions, and the possibility of actively recording attendance in class may have altered student behavior, such results are not conclusive. Additionally, this study was performed prior to the advent of lecture-capture technology. Access to recorded lectures may serve as an ameliorating factor on students' academic performance in the face of absenteeism.

In an Agricultural Economy course, Devadoss and Foltz (1996) evaluated several factors including attendance, motivation, and prior GPA on academic achievement. They found that when controlling for other variables, class attendance was still a significant contributing factor to grade on average accounting for a 0.45 point higher grade on a 4.0 scale when compared to students who only attend half of the class periods (Devadoss & Foltz, 1996). Another study evaluating students' attendance in a college biology course found that no student who attended class less than 80% of the time received an A in the course, and students that attended 81-100% of the time had a 95% chance of at least getting a C in the course (Moore, 2003).

Colby (2015) examined the relationship between attendance and performance, and developed some specific guidelines for instructors to follow. He developed the "70% Rule" which stated that, based on his data, if a student did not attend at least 70% of teaching sessions they had a two in three (66.7%) chance of failing the course but if they attended 80% of the lectures their chance of failing the course dropped to a 50% chance. The original work was presented in abstract form in 2004, but not published until 2015. This study was repeated by Newman-Ford, Fitzgibbon, Lloyd, and Thomas (2008) and by Guleker and Keci (2014) who found similar results. Newman-Ford et al. (2008) reported students attending less than 70% of

class have a one in three (33.3%) chance of failing compared to students with a 90% or less attendance who had a one in four (25%) chance of receiving a failing grade. Guleker and Keci (2014) reported students who attended less than 70% of class had a two in three (66.7%) chance of failing the course compared to students who attended less than 85% of the course having a three in eight (37.5%) chance of failing. In summary, these studies demonstrate that students who attend less than 70% of lectures may be at higher risk for course failure.

Student and Faculty Perception of Lecture-Capture Technology. There can be a divergence of opinion between students and faculty regarding lecture-capture technology (Kwiatkowski & Demirbilek, 2016; Marchand et al., 2014; Maynor et al., 2013; Toppin, 2011). From a learning perspective, students report that viewing recorded content and attendance of live lectures to be equivocal in regards to their ability to learn the content material (Cardall et al., 2008; Marchand et al., 2014). Faculty generally form different opinions including perceptions that live lecture enhances the learning experience by allowing students to ask questions, engage with the instructor, and promote active learning (Bollmeier et al., 2010; Kwiatkowski & Demirbilek, 2016; Leadbeater et al., 2013; Marchand et al., 2014; Maynor et al., 2013); none of which can be accomplished when students replace attendance with viewing capture-recorded lectures.

Students largely report that the presence of lecture-capture does not negatively impact their decision to attend class (Cardall et al., 2008; Groen, Quigley, & Herry, 2016; Marchand et al., 2014). There are some contradicting studies however where students do report an increased likelihood to not attend class when recorded materials are available. In a survey, 37% of student respondents reported that having access to recorded materials negatively impacted their attendance behaviors in a large, 300-student introductory genetics course (Holbrook & Dupont, 2009). Other studies have reported similar findings where one-quarter to one-third of students report that access to recorded materials encourages students to miss class (Brotherton & Abowd,

2004; Harley et al., 2003). In management, engineering, and nursing students, 86.5% reported that they would attend traditional lecture or attend traditional lecture and utilize recorded materials together whereas only 11.9% reported they would utilize recorded materials alone (Fei et al., 2013). Thus, student self-reported attendance is variable and, given the likely multifactorial nature, cannot be generalized from one course to another.

Pharmacy students self-reported missing less than one class per week (Marchand et al., 2014). In a survey conducted of Harvard medical students, 47.8% reported that they regularly attend lecture and 18.2% reported that they rarely attended live lecture, while the remaining participants indicated that their attendance varied (Cardall et al., 2008). The most commonly cited reasons for missing a lecture among a group of engineering students included their perceived ability to learn the material on their own, diminished ability of the lecturer, and the perception that the content was unimportant (Petrović & Pale, 2015). Interestingly, in their study of medical students Cardall et al. (2008) reported that approximately 10% of lectures were not viewed in either live or recorded form. This would indicate that students obtained the content through another method such as reading course notes or textbook or did not review the content at all.

Conversely, it is a commonly held belief of the faculty that student attendance is negatively impacted by the availability of lecture-capture technology (Kwiatkowski & Demirbilek, 2016; Marchand et al., 2014; Maynor et al., 2013; Toppin, 2011) with faculty commonly perceiving a 20-30% drop in attendance and up to a 40% drop in attendance as a result of lecture-capture (Marchand et al., 2014). Lokuge Dona et al. (2016) reported that when asked, only 28% of faculty would like to see lecture-capture expanded in their units and the remainder reported they did not want their lectures recorded at all. Despite the concern of reduced attendance and a possible subsequent reduction in learning, the majority of students feel that

lecture-capture technology positively impacts their ability to learn and advocate its presence in the classroom (Marchand et al., 2014; Maynor et al., 2013; Toppin, 2011).

How and Why Students Use Lecture-Capture. To appreciate why students perceive that lecture-capture positively impacts learning, educators must develop an appreciation for how and why students utilize this technology. Enhanced ability to take or refine notes is commonly cited among students as a major reason to review recorded lectures (Danielson et al., 2014; Leadbeater et al., 2013; Lokuge Dona et al., 2016); which may be even more important to students with learning disabilities or non-English speaking students (Leadbeater et al., 2013). Even for native speaking, non-learning disabled students, note-taking can result in cognitive overload and has been reported to potentially result in up to 50% of key content being missed (Bollmeier et al., 2010). Simply knowing that the lectures are being captured allows students to focus on the content rather than note-taking, which might promote a deeper understanding of the material (Marchand et al., 2014).

Viewing recorded lectures enables students to stop and start the lecture at will and therefore allows for self-paced learning. This feature is highly valued by learners with approximately 10-20% of learners reporting watching lectures at their own pace allowed for improved understanding of the material (Cardall et al., 2008; Maynor et al., 2013). When students were asked to rate how viewing recorded lectures impacted their perception of improved understanding of material and information retention on a Likert scale (1 = strongly disagree, 2 = somewhat disagree, 3 = neither agree nor disagree, 4 = somewhat agree, 5 = strongly agree), the mean student rating was 4.5 and 4.4, respectively, indicating that students felt access to recorded lectures enhanced their overall learning (Marchand et al., 2014). Having access to recorded lectures allows students another way to self-pace their learning and self-paced learning has been linked to increased retention and learning outcomes (Petrović & Pale, 2015).

The demands placed on students' time are high, particularly in professional degree programs. Playback of recorded materials can be altered in several ways including stopping/starting and increasing or decreasing the playback speed. This provides learners with specific tools to better budget their time on task and customize their learning to fit their individual needs. Students report that viewing recorded lectures at increased speed allowed for additional time for both learning goals, such as review of additional course material, and non-learning goals, including improved school-life balance and stress management (Cardall et al., 2008; Lokuge Dona et al., 2016). Even students who attend live lecture and utilize capture-recorded lectures to supplement their learning do so in strategic ways by reviewing select portions to clarify content, learn difficult concepts, or enhance notes rather than view the entire lecture a second time (Cardall et al., 2008; Danielson et al., 2014; Leadbeater et al., 2013; Traphagan, Kucsera, & Kishi, 2010).

When evaluated through the lens of self-regulation learning theory, highly self-regulated learners would utilize lecture-capture as a tool to further enhance their understanding and manage their resources to obtain overall academic success. Highly regulated students may elect to not attend class and opt instead to view lecture-captured recordings. The technology allows for learners to speed up or slow down captured lectures, which in turn enables the learner to watch a fifty-minute lecture in twenty-five minutes. In the veterinary curriculum of the evaluated College of Veterinary Medicine, this could translate into seventy-five minutes per day or over six hours of time saved per week. When medical students were queried about why they may choose to alter the playback speed of a recorded lecture, 63% percent reported the primary reason was to enhance efficiency in watching lectures. When asked what they did with this reclaimed time, 24% reported they re-invested it into studying (Cardall et al., 2008). This is an outstanding example of the student with high self-regulation. In this scenario, students utilize the technology to regulate their time management and subsequently their overall learning.

Students report that one of the primary reasons they utilize lecture-capture is to clarify and improve notes or revisit material that was unclear (Cardall et al., 2008; Groen et al., 2016; Marchand et al., 2014). There is concern for students in class missing key concepts for several reasons including lack of cognitive engagement or cognitive overload. The rate of speech averages two to three words per second whereas the note-takers ability to write average 0.2 to 0.3 words per second (Piolat, Olive, & Kellogg, 2005). As students hold an idea in working memory so it can be transcribed to notes, they may miss crucial concepts from the instructor (Cohn, Cohn, & Bradley, 1995). Additionally, this consumption of working memory may negatively impact their ability to comprehend and learn. One study reported that taking notes is more taxing on working memory than is comprehension (Piolat et al., 2005). Here again we see the potential for highly self-regulated students to better learn content. In a cohort of pharmacy students, 6% reported that the presence of lecture-capture enabled them to participate more in class discussions because they were less concerned about having to take notes (Marchand et al., 2014). These variables, presumably with numerous others, most likely contribute to the complex relationship between attendance and viewing recorded lectures in this study and others.

Impact of Lecture-Capture on Performance and Attendance. As discussed earlier, many faculty members hold the belief that capture-recording lectures may negatively impact student attendance. Several studies have been conducted that evaluate the impact of lecture-capture and students' attendance. Kinash, Knight, and McLean (2015) conducted a comprehensive literature review examining lecture-capture as it relates to attendance and achievement. They identified 19 publications that commented on achievement and/or attendance from 2006 to 2013. Of those, five did not evaluate attendance. Fourteen publications did evaluate attendance, 11 of which found no significant impact on attendance and three reported a negative impact on attendance (Kinash et al., 2015). However, the majority of studies evaluating student attendance was assessed by survey methodology where students were asked if they came

to class or not (Kinash et al., 2015). This methodology of documenting attendance is concerning for the risk of recall bias as well as social desirability bias (Cardall et al., 2008).

Some studies have evaluated student attendance through non-survey techniques. Bollmeier et al. (2010) evaluated the impact of lecture-capture on student performance and also evaluated attendance. In this study, investigators collected attendance data in aggregate, or counting the number of students present, over the course of the semester. No significant correlation between attendance and performance was discovered in this group (Bollmeier et al., 2010). A disadvantage to this study design was that attendance was collected in aggregate form in an attempt to reduce the impact of documenting attendance on students' behavior. However, this attendance collection method does not allow for direct comparison between individual students' attendance and performance. Additionally, only aggregate data for the number of views for each class session were available. Again, as these data were only available in aggregate, investigators were unable to evaluate correlations for individual student behaviors.

Several studies have examined why students decide to attend class. This appears to be multifactorial and includes both student and instructor influences. Students' decisions to attend lecture are impacted by numerous factors including course expectations (attendance policies, pop-quizzes, or other in-class assignment), cost-benefit ratio to maximize learning, instructor style and personality, perceived ability for lecture to enhance learning, and issues surrounding their personal lives (Billings-Gagliardi & Mazor, 2007; Cardall et al., 2008; Maynor et al., 2013). Students are significantly more likely to attend classes that are more interactive or group based than those that are purely lecture based (Danielson et al., 2014).

Ultimately, the decision to attend class is rooted in student motivation. Some students cite a lack of motivation to view recorded lectures as their primary reason to attend live lectures (Cardall et al., 2008). In one study, around 17% of 206 students surveyed reported attending all

lectures, but the remaining students made a day-to-day decision to attend class and considered cost-benefit to their learning as a major influencing factor (Billings-Gagliardi & Mazor, 2007). Students, particularly those in a professional program given the high content load, quickly learn to budget their time to increase learning and the advent and implementation of lecture-capture software has further impacted how students make these decisions (Billings-Gagliardi & Mazor, 2007; Cardall et al., 2008; Maynor et al., 2013).

Research Questions

Students may utilize a variety of techniques to regulate their learning. The development of lecture-capture technology allows students the opportunity to view a lecture when they choose, to watch at increased or decreased playback speed, to pause playback to more accurately collect notes, and to view lectures repeatedly to better understand concepts. The relationships between class attendance, class performance, and viewing behaviors of recorded lectures need additional clarification. This study will attempt to answer the following:

- RQ1: What is the relationship between attendance, viewing of recorded lecture-captures, and performance in veterinary students at a US College of Veterinary Medicine?
- RQ2: Do students with high attendance perform better than students with low attendance with the addition of lecture-capture technology?
- RQ3: Do students that attend class view fewer recorded lectures than students who do not attend class?

CHAPTER III

METHODOLOGY

This chapter will provide a detailed description of the research design and methods. The initial discussion will be on research design and provide additional background information on the population as well as outline specifics on the selected design.

Research Objective

The objective of the study was to determine if a relationship exists between student attendance, performance in coursework, and viewing habits of capture-recorded lectures. Prior work has demonstrated a difference between class attendance and overall performance in the course with one study finding that students who attended class 100% of the time on average earn a grade of B+ whereas students who attend only 25% of the lectures on average earn a grade of C- with attendance accounting for 31% of the overall variance (Romer, 1993).

This study will expand on this work by examining the relationship between attendance and performance with the addition of lecture-capture technology. Additionally, this study utilized a passive method of attendance documentation by concealed time-lapse photography. This method of attendance documentation was thought to be less likely to alter student attendance behavior when compared to other methods including sign-in sheets, roll, or response software.

Research Design

The study was approved by the University Institutional Review Board. Three variables were evaluated: (a) individual class attendance, (b) individual performance, (c) and individual viewing habits of capture-recorded lectures. Data collection occurred in the spring semester of 2017 at a US College of Veterinary Medicine. Broadly, students' attendance was documented using time-lapse photography, viewing habits of recorded lectures was tracked by lecture-capture software (Echo360, 2018), and performance for each course reported as a final percentage grade was evaluated at the conclusion of the semester. At the end of the semester, students were informed of the study, the purpose of the study, and provided an opportunity to opt-out of the data analysis.

Participants

Population. Students at the College of Veterinary Medicine are designated by year in the program; first year students (VM1), second year students (VM2), third year students (VM3), and final year students (VM4). The curriculum is arranged such that the first three years are lecture-based and the final year is clinical training where students work in the University Veterinary Medical Teaching Hospital under the supervision of licensed veterinarians. VM1, VM2, and VM3 students have designated lecture halls where all of the lectures occur over the course of the semester. There are approximately 80 students per year and approximately 320 total students in the professional curriculum at the College of Veterinary Medicine.

Sample. Data was collected from all students designated as VM3. This was a convenience population selected based on lecture hall design. This lecture hall has front facing, auditorium style seating with sufficient row elevation to allow for each students' face to be clearly identified from the front of the lecture hall. This was important so that a single, fixed camera placed at the front of the room could be utilized to document attendance.

Course Information. All courses evaluated in this study are team-taught by faculty. The number of faculty instructors varies within each course with Neurology and Urinary having five instructors, Alimentary having eight instructors, and Cardiopulmonary having 11 instructors. All courses have a similar format where general pathology concepts are reviewed followed by more in depth discussions of diseases specific to small animal patients (canine and feline), food animal patients (predominately bovine and porcine), and equine patients. Additionally, all exams are of a similar format and comprised of matching, true/false, and multiple choice questions with rare short (one or two word) answer. Furthermore, several instructors teach in more than one of the courses for this particular semester.

Data Collection

The described research protocol was approved by the University's Institutional Review Board prior to data collection (Appendix A). Data regarding attendance, lecture-capture recorded video views, and performance as determined by final percentage grade were collected for all VM3 students over the course of the spring 2017 semester in four courses; Course A, Course B, Course C, and Course D. These four courses comprised the entirety of the VM3 spring curriculum with the exception of elective courses. Data were only collected from the core curriculum and not from elective coursework.

Attendance. The selected College of Veterinary Medicine itself does not have a mandatory attendance policy and instead allows the instructor of record for each course to decide his/her own policy on attendance. The syllabi for each course were reviewed for a policy on attendance. All syllabi contained a similar policy on attendance where attendance was encouraged or expected. However, no course or instructor documented attendance in any course.

It was felt that actively documenting attendance through any method could result in bias in the population; or a Hawthorne effect. Therefore, the decision was made to document

attendance by using a concealed camera and time-lapse photography. A small camera (GoPro, 2018) was placed at the front of the VM3 lecture hall. The camera was concealed behind existing hardware to avoid drawing attention to its presence. The camera was selected based on its small size to allow for easier concealment and its ability to access images using remote software. The camera itself does not allow for prolonged time-lapse image collection. Therefore, a programmable intervalometer (CamDo, 2018) was attached to the camera . The intervalometer allowed the camera to be programmed to collect images at specific times on specific days.

VM3 core courses are scheduled at 8:00 AM, 9:00 AM, and 10:00 AM Monday through Friday with one course meeting daily, and other courses meeting two or three times weekly. The intervalometer was programmed to capture a single image every 10 minutes during these class periods. Collecting an image every 10 minutes increased the likelihood that a given student would be facing forward and looking up so that their face could be identified by the investigator to document attendance. The investigator periodically downloaded images by use of remote software (GoPro App, 2018), saved images by date/time data, and then deleted images from the camera. Images were then transferred to a password-protected computer for later evaluation. At the conclusion of the semester, a single observer reviewed all images and documented individual student attendance for each class period over the course of the entire semester.

Student viewing behavior of lecture-capture recordings. The lecture-capture software utilized by this College of Veterinary Medicine at the time of the study was Echo360 (Echo360, 2018). As a policy, all lectures given at this College of Veterinary Medicine were lecture-captured and the software was programmed to record scheduled lectures automatically. These lectures were then posted to the learning-management software used by the college, in this case Moodle (Moodle, 2018). Access to recordings was granted to students through their unique identification and password. Echo360 software catalogs which students accessed recordings, which recordings were accessed, when recordings were accessed, and how many times they were

accessed. These data were retrievable from the class as a whole as well as for individual students. It is critical to note that Echo360 software was unable to track which portion of recordings students view or how long they view a recording. Once a student accessed a video it is documented, but there is no mechanism to evaluate if the student watched all or part of a recording or how long they spent viewing each recording. Therefore, for the purposes of this study a single view was defined as a student accessing the recorded lecture file. Analytics beyond merely accessing the file could not be obtained. At the conclusion of the semester, the total number of times an individual student accessed recorded lectures for each course were obtained. A combined total number of lecture-recordings accessed for the entire semester for each student was calculated by adding their individual number of recorded-lecture views in each course. The total number of recording views in each course as well as the number of recording views in all core courses were utilized for data analysis.

Performance. At the conclusion of the semester, student grades for each core course in the VM3 curriculum were retrieved through the Director of Student Services Office of the College of Veterinary Medicine. To help protect identity, once attendance and viewing behavior data were compiled, grade data was added and all identifying information, including student name and ID number, were removed from the dataset.

Student participation. During the 14th week of the semester, the study and its details were revealed to the student population. To ensure all students had been notified, an announcement was made to the class by the investigator and an email explaining the study specifics was sent to each VM3 student. Students were also provided with an opt-op document if they did not wish for their individual data to be included in the analysis. Again, the decision was made to wait until the conclusion of the semester to disclose the study to the student population to eliminate the bias on student's choice to attend class. There was concern that if students knew attendance was being documented, this might influence the student's decision to attend class.

Over the course of the 2017 spring semester, student attendance was documented via time-lapse photography using a concealed camera. Images were collected Monday through Friday from January 16, 2017 to April 19, 2017, totaling 13 weeks. Due to a technical issue with the camera, there were three days that photographs were not collected. Classes were held on all days during this timeframe with the exception of Martin Luther King Day and spring break. No inclement weather days or unexpected class cancellations occurred during the study period. Of the 62 days where the camera was in place and students were scheduled to be in class, images were successfully collected for 59 days, or 95.2% of the time.

A single image was collected every 10 minutes from 8:00 AM to 12:00 PM and 1:00 PM to 5:00 PM Monday through Friday. The decision to collect images during this timeframe was made to ensure that if a class was rescheduled due to weather or for other reasons; documentation of attendance would not be impacted. This resulted in a total collection of over 4,500 still images in the designated lecture hall. Appendix B contains a single still image collected from the data set where no students are present as an example image. The period of interest was 8:00 AM to 11:00 AM, or 3 hours, when VM3 core courses were scheduled for the semester. When this scope was narrowed, it resulted in 1,121 images that were reviewed to document attendance in the study population. Individual student's attendance was documented for every class session for each day of the 59 days where images were collected.

Two methods were used to confirm the identity of the students. The first method consisted of identifying students by use of a class composite which was constructed the first year of their veterinary program. This meant that the images in the composite were around two and a half years old. Secondly, two faculty members in the College of Veterinary Medicine were consulted to ensure that each student was identified correctly in the first week's images. After confirming the identity of each student, a seating template was created. Students do not have assigned seating in any of the courses; however, students tended to sit in the same seats over the

course of the semester. This behavior allowed for easier and faster identification of students using the seating template. The primary image utilized to document attendance was the image collected 10 minutes after the start of the course period. This image was selected to allow for students that may be a few minutes tardy.

Eighty students were enrolled in the VM3 curriculum at the time of the study. Every student could not be identified in every image because they were looking down or turned away from the camera. However, every student's identity could be confirmed in at least one of the five images collected during each 50-minute class period. The initial population consisted of 80 VM3 students, 64 (80%) female and 16 (20%) male. One student (1.25%) elected to opt-out of the study and the final data set was comprised of 79 students, 63 (79.7%) female and 16 male (20.3%).

Data for course grades were obtained from the Director of Student Services office at the conclusion of the semester. Recorded lecture-capture viewing data were collected at the end of the semester for each core course of the semester. The course specific data was then combined to form a total number of recorded lecture-capture views. Faculty instructors were not made aware of the study until the conclusion of the semester so as to avoid any potential bias.

All data analyses were performed using IBM SPSS 23.

CHAPTER IV

RESULTS

Relationships Between Variables

- RQ1: What is the relationship between attendance, viewing of recorded lecture-captures, and performance in veterinary students at a US College of Veterinary Medicine?

To evaluate the relationships between student attendance, performance, and recorded lecture-capture views (as defined as the number of times students accessed the lecture-capture recording), a Pearson's correlation was utilized. Correlations were performed between attendance and performance, attendance and recorded lecture-capture views and performance and recorded lecture-capture views. A significant positive association between students' course attendance and course performances were found in all courses as well as overall attendance and performance (Table 1). A significant negative association between students' course attendance and viewing of recorded lectures was noted in all courses as well as overall attendance and total number of captured lectures viewed (Table 2). A negative association between students' performance and viewing of recorded lectures was noted in all courses. However, this relationship only reached significance in two courses, Course B and Course D (Table 3).

Table 1

Correlation for Course Attendance & Performance

	Course A Att	Course B Att	Course C Att	Course D Att	Overall Att	Course A Grade	Course B Grade	Course C Grade	Course D Grade
Course B Att	.920**								
Course C Att	.912**	.934**							
Course D Att	.917**	.853**	.947**						
Overall Att	.973**	.956**	.980**	.959**					
Course A Grade	.332**	.358**	.357**	.285**	.346**				
Course B Grade	.278*	.302**	.325**	.277**	.306**	.758**			
Course C Grade	.238*	.252*	.260*	.219	.250*	.844**	.687**		
Course D Grade	.278*	.330**	.383**	.301**	.334**	.831**	.752**	.783**	
Overall Grade	.308**	.340**	.363**	.297**	.339**	.939**	.881**	.907**	.922**

** Correlation is significant at the 0.01 level.

* Correlation is significant at the 0.05 level.

Table 2

Correlation for Course Attendance & Lecture-Capture Views

	Course A Att	**Course B Att**	**Course C Att**	**Course D Att**	**Overall Att**	**Course A Views**	**Course B Views**	**Course C Views**	**Course D Views**
Course B Att	.920**								
Course C Att	.912**	.934**							
Course D Att	.917**	.853**	.947**						
Overall Att	.973**	.956**	.980**	.959**					
Course A Views	-.306**	-.242*	-.326**	-.352**	-.317**				
Course B Views	-.259*	-.266*	-.299*	-.284*	-.283*	.820**			
Course C Views	-.216	-.176	-.241*	-.248*	-.227*	.888**	.869**		
Course D Views	-.320**	-.270*	-.339**	-.338**	-.329**	.802**	.758**	.770**	
Overall Views	-.286*	-.242*	-.313**	-.321**	-.300**	.955**	.914**	.965**	.873**

** Correlation is significant at the 0.01 level.

* Correlation is significant at the 0.05 level.

Table 3

Correlation for Course Performance & Lecture-Capture Views

	Course A Grade	Course B Grade	Course C Grade	Course D Grade	Overall Grade	Course A Views	Course B Views	Course C Views	Course D Views
Course B Grade	.758**								
Course C Grade	.844**	.687**							
Course D Grade	.831**	.752**	.783**						
Overall Grade	.939**	.881**	.907**	.922**					
Course A Views	-.092	-.098	-.126	-.166	-.137				
Course B Views	-.223*	-.247*	-.187	-.259*	-.252*	.820**			
Course C Views	-.160	-.176	-.118	-.218	-.185	.888**	.869**		
Course D Views	-.202	-.237*	-.220	-.243*	-.248*	.802**	.758**	.770**	
Overall Views	-.168	-.190	-.162	-.228*	-.206	.955**	.914**	.965**	.873**

** Correlation is significant at the 0.01 level.

* Correlation is significant at the 0.05 level.

Attendance

Average attendance for VM3 students overall was 80.5% (range: 30-100%) with a standard deviation of 18.5%. Average attendance for the individual courses (Course A, Course B, Course C, and Course D) were 80.5% (26.8-100%, SD = 19.0%), 82.0% (14.3-100%, SD = 19.4%), 79.4% (26.8%-100%, SD = 18.6%), and 80.9% (26.7-100%, SD = 19.3%) respectively.

Academic Performance

At the conclusion of the semester, students' final percentage grades for each core course were obtained from the Director of Student Services office in the College. To control for non-core or elective courses and their influence on students cumulative semester GPA, an average grade for each student was created based on their scores in the individual core courses. This was designated as the overall grade for the semester for the purpose of data analysis. Average performance for VM3 students overall in the core curriculum was 87.3% (range: 74.2-97.1%) with a standard deviation of 5.4%. Performance for individual courses (Course A, Course B, Course C, and Course D) were 88.6% (72.8-98.6%, SD = 5.6%), 86.4% (69.7-98.4%, SD = 6.2%), 84.0% (73.3-97.0%, SD = 5.9%), and 90.3% (75.7-101%, SD = 5.9% respectively. Of the 79 students included in data analysis, 27 received a grade of 'A', 44 a grade of 'B', and only eight receiving a grade of 'C'. No student received a 'D' or 'F' grade in any course in the semester.

Recorded Lecture Views

Average total recorded lecture-capture views for VM3 students during the semester was 64.66 views (range: 0-213) with a standard deviation of 56.19. Recorded lecture-capture views for the individual courses (Course A, Course B, Course C, and Course D) were 19.99 (0-70, SD = 17.77), 9.76 (0-41, SD = 9.89), 23.16 (0-84, SD = 21.69), and 11.75 (0-35, SD = 10.6) respectively.

Impact of Attendance and Lecture-Capture Views on Performance

For analysis, attendance data were recoded into groups based on quartile with the first quartile representing the poorest attending students and the fourth quartile representing the highest attending students. The students with poorest attendance and the students with the highest attendance were then evaluated against performance, as determined by final semester grade, and number of recorded lecture-capture views. For normally distributed data, independent t-tests were performed and for nonparametric data Mann-Whitney U test was utilized.

RQ2: Do students with high attendance perform better than students with low attendance with the addition of lecture-capture technology?

Significant differences in performance were found between students having the highest and lowest attendance in the Course A, Course B, Course D, and Overall performance (Table 4). No significant difference in mean grade was found in lowest attendance and highest attendance groups in Course C (Table 5).

Table 4

Comparing Lowest & Highest Attendance and Grade (Courses A, B, & C)

	N	M	SD	t	Sig.
Course A Grade				-2.08	.044
Lowest Attendance	18	85.9	6.2		
Highest Attendance	21	89.7	5.3		
Course B Grade				-2.06	.045
Lowest Attendance	23	84.3	6.4		
Highest Attendance	24	87.8	5.3		
Course C Grade				-1.49	.144
Lowest Attendance	22	81.5	5.2		
Highest Attendance	18	84.0	5.6		
Overall Grade				-2.50	.017
Lowest Attendance	19	84.9	5.3		
Highest Attendance	19	88.9	4.5		

Table 5

Comparing Lowest & Highest Attendance and Grade (Course D)

	N	Mdn	U	Sig.
Course D Grade			107.0	.012
Lowest Attendance	20	88.1		
Highest Attendance	20	92.3		

RQ3: Do students that attend class view fewer recorded lectures than students who do not attend class?

The Mann-Whitney U test was utilized to evaluate the number of recorded lecture-capture views that students watched between the highest attendance and lowest attendance groups. This demonstrated a significant relationship in the Course A, Course B, Course D, and the Total views of recorded lecture-captures over the semester, but no significant difference in median views was demonstrated in Course C (Table 6).

Table 6

Comparing Lowest & Highest Attendance and Recorded Lecture-Views

	N	Mdn	U	Sig.
Course A Views			101.5	.013
Lowest Attendance	18	27.0		
Highest Attendance	21	3.0		
Course B Views			163.5	.015
Lowest Attendance	23	10.0		
Highest Attendance	24	1.0		
Course C Views			132.5	.074
Lowest Attendance	22	28.0		
Highest Attendance	18	10.0		
Course D Views			104.5	.009
Lowest Attendance	20	14.0		
Highest Attendance	20	2.5		
Overall Views			103.0	.023
Lowest Attendance	19	73.0		
Highest Attendance	19	9.0		

CHAPTER V

CONCLUSION

The goals of this study were to further define the relationships between student classroom attendance and academic performance in the presence of lecture-capture technology. This chapter will discuss the study findings in context of the theoretical framework, relate to prior literature, and highlight weaknesses within this study.

Attendance and Performance

In this population, class attendance was significantly and positively correlated with academic performance. A moderate correlational strength was found for overall grade as well as in every course except for Course C, which had a smaller correlation strength of .260. Based on the Pearson correlation coefficient, attendance accounted for 6.8% to 11.5% of the variation in academic performance. This finding is not unsurprising in light of prior works demonstrating the relationship between attendance and academic performance (Kinash et al., 2015; Moore, 2003; Romer, 1993).

The decision to attend, or not attend, class is multifactorial. Broadly speaking, these would include student factors, instructor factors, social factors, or environmental factors. As it relates to student factors, these include personal or family related situations that may prevent a student from attending a course. Personal illness, illness of a child, death of family member,

change in spouse or partner's schedule, and numerous other factors can result in absenteeism. Individual motivational factors and interest in the content can play a tremendous role in a student's day-to-day decision to attend or miss class. Friedman, Rodriguez, and McComb (2001) found that individual motivation, type of course (humanities, natural sciences, professional, mathematics, etc.), and class size were all reported by students to influence their decision to attend class.

Instructors also play a role in a student's decision to attend class, both directly and indirectly. Direct actions would include a policy on attendance or routine utilization of pop-quizzes in an attempt to maintain consistent attendance. A mandatory policy attendance has been demonstrated to result in a small increase in grade in a few studies (Crede, Roch, & Kieszczynka, 2010). A survey of dentistry students demonstrated that their recalled attendance was higher for courses where points for in class quizzes were awarded compared to courses where no in-class assignments or points were offered resulting in a difference in reported attendance of 95.2% versus 57.8% (Azab et al., 2016). Conversely, there is a collection of works that demonstrate no significant improvement to academic achievement when attendance policies are implemented (St. Clair, 1999). Examples of indirect influences that instructor may contribute to a student's decision to attend class include their personal lecture styles, use of humor, immediacy, and personality (Devadoss & Foltz, 1996; Garner, 2006; Rocca, 2004).

Again, these are only a few of the factors that influence a student's decision to attend class. It is important to note that there is not a cause and effect relationship between attendance and academic performance. In the context of self-regulated learning theory, students with a high degree of self-regulation would be capable of making good attendance choices. He or she would understand their limits on content acquisition and individual learning and subsequently regulate their attendance accordingly. In contrast, students with poor self-regulation may be incapable of making good attendance decisions. Lukkarinen, Koivukangas, and Seppälä (2016) evaluated

attendance and performance in a unique way by subdividing students into three groups (one = students who did not attend the final exam – dropped the course, two = students who attended class and attended the final exam, and three = students who had poor class attendance but attended the final exam). In group two, they found that, similar to other studies, attendance was positively correlated with performance. However, the third group is of particular interest as it pertains to self-regulated learning. Investigators contacted this cohort and asked two questions: "What influenced your decision to not attend class?" and "What, in your view, enabled you to pass the exam nonetheless?" Responses indicated these individuals had conflicting schedules with work or school yet they invested a significant amount of time on the course in self-study (Lukkarinen et al., 2016). Despite missing lectures, this group of students were able to successfully learn the material and pass the final examination at the conclusion of the semester, a pattern consistent with self-regulated learners.

Even though instructors may mandate that students attend class, this does not ensure cognitive engagement, interest, and learning. Rather than implementing a forced attendance policy, which may not be of any benefit to highly regulated learners; it may be useful for instructors to view poor attendance as a bellwether of possible poor academic performance. Students who have both poor attendance and poor academic performance may have poor self-regulation skills and may benefit from some form of instructor intervention. Students who have poor attendance and strong academic performance will likely not benefit further from an attendance policy. One could argue that a forced attendance policy in this cohort of student may have a negatively effect on motivation which could subsequently and, inadvertently, result in decreased learning.

The mean semester attendance was 80.5% with a range of 30-100%. The mean attendance for students in the lower quartile was 52.2% compared to a mean attendance of 96.4% for students in the upper quartile of attendance. The mean semester overall performance was

87.3% with a range of 74.1-97.1%. The mean overall grade for poorest attending students was found to be 84.9% whereas the mean overall grade for the highest attending students was found to be 88.9%. Although statistically significant, the mean difference in grade between lowest and highest attending students is small (4.0%) considering that highest attending students came to class nearly twice as often than lowest attending students. As mentioned previously, no student received an average grade of 'D' or 'F' in any course in the semester. This finding is likely due to the population that was evaluated. This cohort of students was in the second semester of the third year of the professional curriculum. Although not directly evaluated, it could be assumed that these students had developed successful study practices, as attested to by their acceptance to a professional training program and their successful history within the program.

The academic attrition rate in veterinary school is low, around 6% (McConnell & Kogan, 2001). This might be in large part related to this population's general approach to learning. A large study, comprised of over 2,500 students, of which around 2,100 were veterinary students, demonstrated that veterinary students most commonly utilize a strategic, or organized, approach to learning (Parpala, Lindblom-Ylänne, Komulainen, Litmanen, & Hirsto, 2010). This strategic approach to learning by veterinary students has been reported in several studies (Ruohoniemi, Parpala, Lindblom-Ylänne, & Katajavuori, 2010; Ryan, Irwin, Bannon, Mulholland, & Baird, 2004; Ward & Walker, 2008). The ability to alter approach to learning is a self-regulated learning strategy (Heikkilä & Lonka, 2006). It is suggested that veterinary students tend to adopt this strategic approach to learning because of the large amount of material with which they are presented (Parpala et al., 2010; Ruohoniemi et al., 2010; Ryan et al., 2004; Sutton, 2007; Ward & Walker, 2008). These data suggest that veterinary students tend to be highly self-regulated learners. As it pertains to this study, this may account for the tremendous range in individual student attendance, despite the relatively small differences in students' grades, and collective successful completion of that phase of the program in the entire study population.

Attendance and Recorded Lecture Views

Class attendance was significantly and negatively correlated with viewing of recorded lectures in all courses. A moderate correlational strength was found between students' overall attendance and the total cumulative number of recorded lecture views. A moderate strength correlation was also found between students' attendance and total course views in Course A and Course D. Course B and Course C were also found to have statistically significant negative correlations, but their relationship was weaker at -.266 and -.241 respectively. Attendance accounted for 5.8% to 11.4% of the variation in the number of recorded lectures viewed.

The mean semester recorded lecture views was 64.66 with a range of 0-213 and a median of 54.0. The mean number of recorded lecture views for students in the lowest quartile for recorded lecture views was 3.74 (median = 19.0) compared to a mean number of recorded lecture views for students in the highest quartile of recorded lecture views of 143.65 (median = 73.0). These data were then compared to students in the lowest quartile for attendance and the highest quartile for attendance. It was discovered that students in the lowest quartile for attendance on average viewed 85.5 recorded lectures compared to students in the highest quartile for attendance which only viewed an of 40.4 recorded lectures; or less than half of the number of recordings viewed by students with the poorest attendance. A statistically significant difference was noted in the number of recorded lecture viewed between lowest and highest attenders except in Course C.

On superficial evaluation, it seems logical that students who do not attend class may be more likely to view the recorded lectures. The relationship between attendance and video viewing behavior is complex. As discussed earlier, students elect to watch, or re-watch, recorded lectures for a variety of reasons including to clarify their notes, review the material or better understand concepts, as well as to make up for missed lectures (Danielson et al., 2014; Leadbeater et al., 2013; Lokuge Dona et al., 2016; Traphagan et al., 2010). Cardall et al. (2008)

found that among medical school students, around 10% of students did not attend lecture nor did they view any recorded lectures. It is assumed that this group of medical students is capable of learning the subject material through other means such as lecture notes, textbooks, and other provided resources. In this study, only total number of lecture-capture views for each course and an individual student's cumulative number of views in all courses were evaluated. A future study could look in more detail at which specific lectures were viewed more frequently.

Recorded Lecture Views and Performance

The number of views of recorded lectures was weakly negatively correlated with performance in all courses, but only reached statistical significance in Course B and Course D with a correlation coefficient of -.247 and -.243 respectively, accounting for only 5.5% to 6.1% of the variation. The mean number of recorded lecture views for students in the lowest and highest quartile for performance (low and high achievers) were evaluated and found to be 83.2 views and 60.0 views, respectively. No statistically significant difference was found in the number of recorded lectures viewed between higher and lower achieving students in any course or in their overall semester grade.

The relationship between the number of recorded lecture views and performance may be more challenging to explain. For two courses, Course B and Course D, a weak, but significant negative relationship exists between these two factors. This would indicate that students with lower grades in these courses viewed recorded lectures more times. However, when comparing the number of recorded lectures viewed for highest and lowest achievers in the course, no significant relationship was found. This would seem to indicate that the correlational relationship may be influenced by other factors and less likely to be directly related. This finding is in opposition to previous reports regarding student viewing behaviors and performance. Prior works have demonstrated that lower achieving students view recording significantly more than higher

achieving students (Groen et al., 2016; McNulty et al., 2009; Owston et al., 2011). When viewing behaviors were investigated further, it was found that higher achieving students would selectively watch portions of the recordings and lower achieving students would watch the entire recording (Owston et al., 2011). Additionally, it was noted that students who reported viewing the entire recording multiple times performed more poorly than students who just viewed the entire recording a single time (Owston et al., 2011).

Returning to the student reported information on how they utilize recorded lectures, many students, particularly students in a professional degree program, report they use them to clarify confusing content, improve notes, and review material for exams (Cardall et al., 2008; Danielson et al., 2014; Leadbeater et al., 2013; Lokuge Dona et al., 2016; Marchand et al., 2014). Therefore, a possible explanation for this finding may be that the material in Course B and Course D is more difficult or presented in an unclear manner. However, when academic performance data are evaluated, we find that students as a whole performed better in Course D than in the other courses with a mean grade of 90.3% (range = 75.7 – 101%, SD = 5.9%). A confounding variable for Course D is the score higher than 100%. On further review of the individual grades in this course, it appears that some form of bonus points were offered, on at least the first examination, with 34 students scoring above a 100% on this examination. The nature of how these bonus points were awarded is unknown and therefore complicates interpretation here.

McNulty et al. (2011) speculated that students struggling in a course may be more likely to seek out additional resources, such as utilization of recorded lectures, providing a possible explanation for the inverse relationship between increased number of recorded lecture views and poorer performance. Unfortunately, the data collected in this study did not capture how students utilized these recordings nor could it be determined for what length of time the recordings were viewed. Perhaps a clearer metric to evaluate in this situation would be to utilize total time spent

viewing recordings. This may provide additional information on if students watched entire recordings or merely portions of recording. If this information was available, it may have provided some inferential information to further clarify content or enhance notes.

The student population was static across all courses, however there is significant variation as it pertains to individual course instruction across courses. All courses are team taught, but predominately utilize different faculty members and different numbers of faculty in each course. It is unclear which, if any, of these variables may have contributed to the negative correlation between number of recorded lectures viewed and academic performance in these two courses.

Limitations

This study has several limitations that warrant further discussion. The first limitation of concern is the definition of "view" for the purpose of this study. The software utilized for lecture-capture, Echo360, provides some analytics for how many times students access a recorded video. Unfortunately, the software only has the ability to document when a student accesses the file. There are no analytical data for how long the student watched the recording, if the recording was sped up, slowed down, or paused. This could have resulted in over and/or underestimations of how students utilized this information. A group of students may have accessed a file and watched a recording together, thus resulting in an underestimation of viewing behavior. Alternatively, a student may have accessed the file by mistake and immediately closed the recording, thus resulting in an overestimation of viewing behavior. A more preferred source of information would have been a percentage of the total recording viewed. This would have allowed for a more accurate depiction of how students were utilizing the video recordings. If students only accessed 5 or 10 minutes, they may have been clarifying confusing content or

checking their notes compared to student who watched the entire lecture which may have demonstrated stronger correlation with absenteeism.

The second limitation here is the purely observational nature of this study. During the study's inception, it was decided that a concealed camera would be the most accurate method for documenting student attendance. It was also theorized that by having students actively opt-out of the study rather than actively signing into the study, there would be improved subject participation. The addition of a survey instrument to further evaluate students' motivations for attending class or viewing recorded lectures would likely have resulted in a decreased participation rate as well. The purely observational methods combined with the opt-out approach resulted in a final participation rate of 98.8%. This is an overall excellent participation rate, but the motivational underpinnings for student behavior can only be extrapolated from previously published works, which may or may not be reflective of the motivations for this cohort of students.

A third limitation may be the manner in which a student was determined to be present or absent in a given class. The image collected 10 minutes after the start of the course period was selected as the primary image on which to base student attendance. This decision was made to allow students to be a few minutes tardy to a given class and not mistakenly be counted as absent. If a student could not be clearly identified with this image, the remaining images for the class period were evaluated to confirm identity. However, if a student was determined to be absent in the image collected 10 minutes after the course started, the student's absence was not confirmed in additional images. Therefore, if a student arrived to class later than 10 minutes after the class began, he or she would most likely have been counted as absent for the entire class period. Conversely, if a student was determined to be present in the image collected 10 minutes after the onset of the class but left class early, that student would have been counted as present for the entire class. This could have resulted in over or under counting individual student absenteeism.

The decision to review the image collected 10 minutes after the start of the class was arbitrarily based on the author's personal experiences that most students are not later than 10 minutes to a class. Additionally, it is the author's experience that students rarely leave class early. The author was unable to find any primary literature to support these anecdotal beliefs.

Future Directions

The work discussed helps to provide a better understanding of the relationship between attendance, academic performance, and students' use of recorded lecture-captures. This study found a positive relationship between attendance and academic performance in all courses evaluated. This finding is consistent with the large body of literature on this relationship. However, the population evaluated here is comprised of historically high achieving and successful students. Studies of undergraduate students have reported that poor attendance, generally less than 70%, is correlated with a high rate of academic failure. None of the students in this study failed a course despite an attendance rate of less than 75% by 25.3% (Course A), 22.8% (Course B), 29.1% (Course C), and 30.4% (Course D) of students. This would seem to indicate that this cohort of students is high in self-regulation or have high level of prior knowledge. Additional studies are needed in this population of students to determine the relationship between self-regulation, prior knowledge, and the variables evaluated here.

Furthermore, additional information is needed in this population of students to address why students decide to come to class, or not to come to class. Prior work on this subject in a medical students reported that students are more willing to attend class if it would positively impact their learning (Billings-Gagliardi & Mazor, 2007). In this study, Billings-Gagliardi and Mazor (2007) gathered feedback from students who commented on the role of instructors and their decisions to attend class with 82% of students reporting prior experiences with the instructor as a major factor for that decision. Groen et al. (2016) asked students why they would choose to

attend class or view recorded lectures and found similar results with students reporting that if they perceived attending class would be of further benefit to their learning they would be more likely to attend over watching the recorded lecture. Reported beneficial aspects were "…enthusiasm and engagement of the instructor, relevant active learning activities, and heightened sense of community in the classroom." (Groen et al., 2016, pp. 11-12). This type of data are currently lacking from the veterinary student population.

It is unlikely that merely requiring students to attend class will result in positive learning outcomes. Instead, instructors should find ways to encourage attendance in students that would be perceived to be of benefit for their learning. This should include increased use of active-learning techniques such as discussion and small group work (Danielson et al., 2014). At a minimum, instructors should critically evaluate their lecture content and decide if in its current format if there is any incentive for students to attend class. If they are merely summarizing findings from textbooks or reading content from the lecture notes, students may be more likely to be absent compared to an environment that promotes interaction and discussion (Danielson et al., 2014; Guleker & Keci, 2014).

Conclusion

The findings of this study support prior works demonstrating a positive correlation between attendance and performance. What makes this study unique however, is the method of attendance documentation. This study utilized a novel approach to record attendance via concealed time-lapse photography. Prior studies discussing the relationship between attendance and performance relied on either student self-reports on attendance, attendance recorded in aggregate, or individual attendance collected during class. These types of techniques could result in social desirability bias, do not allow for individual comparison of attendance and performance, or could directly bias the population by directly recording attendance. The results reported here

should not be subject to these types of bias and provide further legitimize the relationship between attendance and performance. Students may hold the viewpoint that attending lecture and viewing recorded lectures are equivocal. This belief is not supported with the data found in this study. It is important therefore that instructors find ways to motivate their students to attend class. Ideally, this would include methods to enhance students' motivation to attend class rather than punishing students for not attending so as to avoid deleterious consequences to highly regulated learners who are capable of learning through other means.

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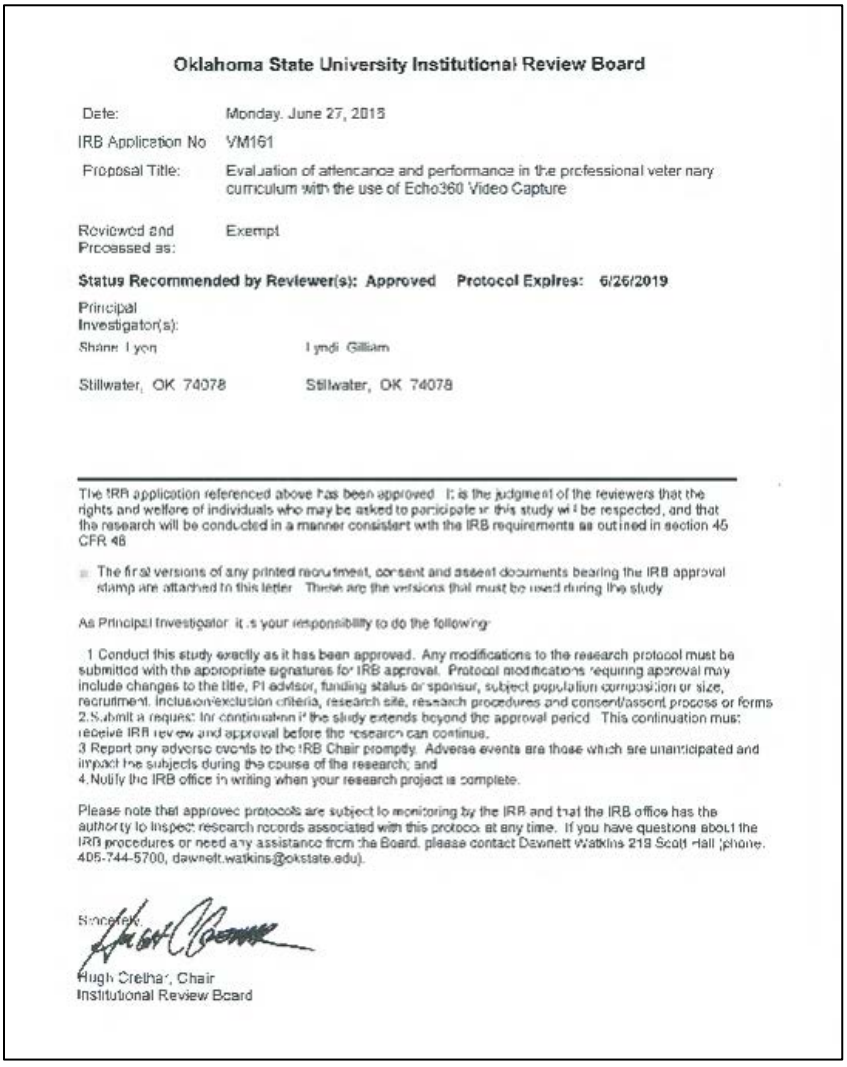
APPENDICES

Appendix A



Oklahoma State University Institutional Review Board

Date:	Monday, June 27, 2016
IRB Application No	VM161
Proposal Title:	Evaluation of attendance and performance in the professional veterinary curriculum with the use of Echo360 Video Capture
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 6/26/2019

Principal Investigator(s):

Shane Lyon	Lyndi Gilliam
Stillwater, OK 74078	Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

The first versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Scott Hall (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Hugh Crethar, Chair
Institutional Review Board

Appendix B

VITA

Shane D. Lyon

Candidate for the Degree of

Master of Science

Thesis: RELATIONSHIP BETWEEN ATTENDANCE, ACADEMIC PERFORMANCE, AND LECTURE-CAPTURE USE AMONG VETERINARY STUDENTS

Major Field: Educational Psychology

Biographical:

Education:

Completed the requirements for the Master of Science in Educational Psychology at Oklahoma State University, Stillwater, Oklahoma in July, 2018.
Completed the requirements for the Doctor of Veterinary Medicine at Oklahoma State University, Stillwater, Oklahoma in 2005.
Completed the requirements for the Bachelor of Science in Biology at Southwestern Oklahoma State University, Weatherford, Oklahoma in 2001.

Experience:

Employed as a Resident in Small Animal Internal Medicine at Kansas State University, Manhattan, Kansas 2006-2009.
Employed as an Associate Veterinarian in Small Animal Internal Medicine at Las Vegas Veterinary Specialty Clinic, Las Vegas, Nevada 2009-2013.
Employed as an Assistant Professor of Small Animal Internal Medicine at Oklahoma State University, Stillwater, Oklahoma 2013-2018

Professional Memberships: American Veterinary Medical Association, 2005-2018. American College of Veterinary Internal Medicine, 2009-2018. American Psychological Association Division 15, Educational Psychology, 2015-2018.