THESIS

THE EFFECTS OF ACTIVE LEARNING, CLASS SIZE, AND INCENTIVES ON STUDENT PERFORMANCE IN LECTURE AND LABORATORY FOR AN INTRODUCTION TO ANIMAL SCIENCES

Submitted by

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ABSTRACT

IMPACTS OF CLASS ACTIVE LEARNING, CLASS SIZE, AND INCENTIVES ON STUDENT PERFORMANCE IN LECTURE AND LABORATORY SETTINGS

In the past few years there has been a notable increase in the use and interest in educational programs centered around using an instructional method known as active learning. The purpose of this study is to determine under what conditions students best perform within laboratory and lecture, while identifying learning gaps that offer potential settings to incorporate active learning. Findings showed that by placing a higher weight on attendance and participation, increases the overall student performance. Class size had little to no effect on student performance, which opens an opportunity to incorporate active learning techniques, leveraging the learning in a classroom, so that educators can spend larger amounts of time interacting with students.

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INTRODUCTION

This study focused on what conditions students best perform within laboratory and lecture, while identifying learning gaps that offer potential settings to incorporate active learning in an introduction to animal science course. Carl Wieman describes active learning's positive impacts on educational outcomes as both "large and consistent." Active learning techniques are designed to "recognize students' diverse learning styles and to promote hands-on application of practice skills in the classroom and field settings. Active learning in the classroom provides an opportunity to use technology and experiential learning can help bridge the gap between cultures. "Active learning can also bridge the gap between the field and the classroom, create in-class learning communities, and promote student collaboration" (Holmes, 2015, 215).

Active learning can be implemented at several levels of education; however, this specialized group of individuals are an optimal choice because they are more apt to have more experience with active learning due to their enrollment or employment at Colorado State University. Majority of college students go through their education with similar teaching methods such as lectures and discussions. "Active learning involves engaging students in higher-order tasks, which is a crucial element of the movement toward learner-centered teaching" (Elliott, 2017, 38). Students who can understand and be involved in active learning throughout their educational experience are more likely to have had effective learning through their personal experiences within their education.

Academic institutions for higher education are also places where students are diversified and intermingling with multiple cultures in a single area. This provides a great window of opportunity to increase multicultural education through active learning where students work with

each other to build new experiences. “A key to the continued existence of every system of privilege is unawareness” (Johnson, 2006, 37). Cross curricular activities are a great way to broaden student’s minds and intermingle a variety of students into completing a single task which builds on multiple courses and involves active learning. The recent cuts to education have led administrators to increase class sizes in all grade levels and subject areas. This study examines the described phenomena as it examines of course with a class size that continuously varied. For this study the class size varied semester to semester with a minimum of 35 students and a maximum of 145 students.

Teaching methods are geared towards advancing learner’s success in meeting course requirements. Active learning which is defined by the University of Minnesota as “an approach to instruction in which students engage with material they study by actively participating in the in their individual learning experiences. This can often increase student participation, engagement, and comprehension of course material. With active learning students will increase their self-esteem and achievement which in turn will assist students in developing unprejudiced attitudes towards others. Several studies have been conducted on the effects of class size on student performance. A study conducted by Iryna Johnson showed in a study of college students in 2010, that within undergraduate programs class size does have a substantial impact on student performance, which affected the achievement of an “A” with lower effects on students with a “C”. The findings produced from the study suggested that student performance could be improved by shrinking class sizes

A study on student responses to grading incentives was conducted by Dmitriy Chulkov where the findings showed that majority of students will put in the effort to conduct assignments for credit. His study was based on how different student types respond to specific incentives on

assignments. This research considers students who are not majoring in the field for the course that was offered, where on average they were less likely to put forth the effort for points, making it necessary to use alternative methods of motivation.

This study has several opportunities to enhance the programs within the College of Agricultural Sciences at Colorado State University. The CAS is dedicated to the unquestioned global preeminence in Agri-tech and the Agri-biome divisions. Which focuses on the safety, security, and continued sustainability of natural resources and agricultural industries. The CAS is committed to contributing to ongoing efforts with the goal to enhance the well-being of humans, plants, and animals. Incorporating active learning and displaying its positive effects on cognitive development, student success, and effective learning in the classroom has the potential to expand the College of Agricultural Science's student base and potentially increase satisfaction for both faculty and students.

The College of Agricultural Sciences has multiple departments including the department of Agricultural and Resource Economics, Animal Sciences, Bio-Agricultural Sciences and Pest Management, Horticulture and Landscape Architecture, and Social and Crop Sciences. The CAS have substantially lower student enrollment than seven of the other colleges within Colorado State University, only competing closely with the Veterinarian Medicine and Biomedical Sciences. The CAS in 2015 reported out of the 21,000 students at CSU, only 1288 students were enrolled in the CAS. Comparatively to 2019 the class size for CSU was 22,615 students of which the CAS had only 1341 students enrolled. Active learning has been proven to show improved scores and retention in students which in turn has the potential to increase enrollment and retention. This study will explore connections between active learning and increased student proficiency in a freshman level introduction to animal science course. This study also offers an

opportunity of motivating or enticing students to want to become more involved or enrolled in the CAS. Which in turn, will overall improve all of CSU by widening its diversity and expanding its colleges through potential students.

PURPOSE STATEMENT AND RESEARCH QUESTIONS

The purpose of this study was to examine student performance in an introduction to animal science course that involved lecture and laboratory. Specifically, this study explored the implementation of active learning, incentives, class size in the classroom for its effectiveness on exam and course scores. For this study one course was used over the period of six semesters. This study was guided by three research questions:

1) How does class size affect student performance?
2) How does laboratory attendance affect student performance?
3) How does laboratory participation affect student performance?

Within these three research questions student performance was evaluated through individual grades for homework, quizzes, tests, web extension resources, and lab variations.

For this study laboratory is where active learning is taking place in the course and lecture uses traditional lecture methodology. Laboratory is considered a setting where active learning takes place because this experience in introduction to animal science utilizes the three-hour period to incorporate hands on learning. For this study active learning is considered student participation in laboratory. Students lab experience is founded on students getting to utilize their knowledge from lecture and textual resources to practice and reinforce the knowledge in a different way. This study looks at the various sections and what changed over time, to identify which were most effective and why. In addition, to evaluating individual student performance, the overall course outcomes will be used to compare lab and lecture outcomes to determine what

culmination of educational performance and teaching methods were best effective. The review of past studies looks at the various interactions and participation patterns of learners in two learning environments.

LIMITATIONS OF THE STUDY

The limitations of the study were; the course utilized varying assignments (data) over time. The course settings, standards, and characteristics varied over time. The data that was gathered was weighed differently semester to semester, while some assignments were added, and some removed. The time to analyze data prior to implementing changes was not possible because the study was conducted after the conclusion of the three years. Informal changes were made making this a practical action research approach, rather than a complete action research examination. Last, there were various semesters that combined attendance and participation in one score while others were accounted for separately.

DEFINITIONS

1) **Active Learning(AL)**—Laboratory for the animal sciences course in the form of participation through any action regarding the involvement of students during their laboratory sections
2) **CAS**—College of Agricultural Sciences
3) **CSU**—Colorado State University
4) **iCEV**-- iCEV is an online learning platform. The content and material provided is required for this course
5) **Cognitive development**—intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from or generated by observation, experience, reflection reasoning, or communication as a guide to belief and action.
6) **PP**—Points possible
7) **Student Performance**—course and attendance scores

STATEMENT OF PROBLEM

Current classroom techniques and teaching methods are not meeting the potential capacity for knowledge to students because the teaching methods used do not keep students' complete interest and attention. Active learning has the potential to transform the way educators teach and how students learn. Active learning furthermore has the potential to expand the understanding of diversity within culture and social justice. Current research has shown that "students value participating in engaging learning activities and also affirmed how active engagement positively impacted their learning" (Wieman, 2014, 8319-8320). Engaging students in true inquiry-based learning where there is immediate relevance to real life application is a challenge many educators are facing.

The environment and its natural resources are also relevant to the modern world especially within agriculture. Learning how to be sustainable and conserve what resources we have left is vital to the future of agriculture. By using active teaching methods, the information and relevance of what is being taught has the prospective of resonating significantly more than lecture-based courses. Students are also facing challenges with eating healthy and gaining proper nutrition. Active learning has the potential to actively educate students on how to eat properly and where to source healthy food. Active learning methods have unlimited potential for every segment of education by enhancing the learning experience and resulting in effective learning not just memorization.

FRAMEWORKS

Skinner (1974) thought that behavior is a function that is reactive to its own consequences and therefore learners will repeat the same behavior if positive reinforcement is being used repetitively. Teaching learning processes shows that there are three types of learning; Formal, Nonformal, and Informal. Some teaching values include informal teaching as the best type of approach where the teacher can be either the instructor or the learner. Informal allows any environment to be used as an educational setting. The informal approach is very flexible and adaptable allowing for experiential and inquiry-based learning with an outcome of problem solving, curiosity, and self-satisfaction.

Active learning must be ensured throughout the educational process. Effective and active learning are both principles that will stick with me as I pursue lifelong learning and teaching. Active learning is especially important within Agricultural Extension and Education. Andragogy and Pedagogy both play major roles in effective learning. Andragogy which is the Adult Learning Theory is centered around experiential based learning while Pedagogy is centered around teacher instruction.

Knowing what motivates people is also important for identifying how to reach students and how to encourage them to learn. Developing a relationship with trust and creating a setting that is open and safe is vital. Students learn well when they can create their own and work with cooperative groups. Active learning hinges itself upon finding something that holds value to students that represents more to them than just points in a grade book.

Determining what motivates teachers is also critical in the implementation of active learning. The central theme to motivating experts is guiding students and helping them develop

for success in life. Many experts also desire to show students challenging opportunities and making their experiences safe and worthwhile.

Positive learning environments begin with equality and which stems from group work interactions and discussion. Group work, especially for youth is a great way to increase social and communication skills which many students lack early in life. It is crucial for the experiential learning cycle to be repeated as many times as possible for effective learning to take place. A research study conducted by Oguzhan Dalkirin to determine the relationship between attendance and academic success. The study was conducted for a course that shares several similarities with ANEQ 101, where the class was composed of 156 students who were divided into two lectures and two laboratories with 624 points possible and 14 weeks of engagement. The study showed a relationship between attendance and student success which was reflected by the total variance of approximately 28%.

Educators utilize evaluations and course grades to identify if what they taught and how they taught was effective. “Evaluation is viewed as essential to decision making and social policy development.” (Guba, 1978, 234). By the time these teachers are reviewing these evaluations and are considering implementing changes or solutions for future classes, it is already too late to make a difference for the previous or current class. “Conventional methods have been disappointing or inadequate,” (Guba, 1978, 234) therefore it is key to identify ways to improve teaching methods, policies, curriculum, and policy.

Educators find it difficult to develop and implement constant course evaluations that they can immediately use to alternate teaching methods or curriculum content for their current classes with the goal of gaging and improving cognitive development. “To better understand individual teaching and contribute to the science of teaching, each educator should examine the full

countenance of evaluation." (Stake, 1967, 523).Utilizing active learning and student-centered techniques are ideologies that have the possibility to transcend any course curriculum. It is critical to understand how students best learn and absorb material. Evaluation of student progress as well as teacher effectiveness is necessary to improve teaching methods and student's cognitive learning.

William Perry also offers a framework of sequential development in college student's "underlying assumptions about knowledge, truth, and values" (Perry, 1968, 110-116). Perry's framework connects with Broughton's epistemological development after relativism. These frameworks are related by the mental development of college students in comparison to youth, which will be used to describe the importance and implications of active learning.

Cognitive learning styles are the information processing habits of an individual. It describes what modes people use for thinking, understanding, and remembering. Cognitive style describes individual dimensions that influence attitudes, beliefs, and action. According to the Multiple Intelligences theory by Howard Gardner if one's "intelligence can be identified, then teachers can accommodate different children more successfully according to their orientation of learning" (Gardner, 1993, 27-34).

Gardner completed his study by exploring people from several walks of life in various socioeconomic conditions. He completed hundreds of interviews and came up with nine intelligences. His research identified visual, verbal, logical, kinesthetic, musical, intrapersonal, interpersonal, naturalist, and existentialist intelligences. If educators can identify which method of teaching appeal to different intelligences, they can then modify their teaching methods to improve cognitive learning.

Every school system and educator utilize different teaching methods that can either hinder or advance a student's progress. Assessments are the most common form of evaluation. According to the University of Gloucestershire "assessment has an overwhelming influence, on what, how and how much students study" (Gibbs, 2005, 30-31). Assessing student's progress is critical in determining if students are performing adequately in their coursework. Assessing teacher's effectiveness is just as important and can be seen through student assessments and teacher evaluations. According to the University of Cumbria, "Assessment strongly influences student's learning. Well designed and managed, it can drive learning more than any other aspect of a student's experience" (Bloxham, 2014, 840).

Teaching methods are geared towards advancing learner's success in meeting course requirements. Active learning which is defined by the University of Minnesota as "an approach to instruction in which students engage the material they study by actively participating in the learning process" (University of Minnesota, 2017), can often increase student participation, engagement, and comprehension of course material. A study done by Grozdanka Gojkov showed that the motivation and success of students are statistically relative when considering student participation. The study also showed that characteristics of learning styles and an active teaching approach showed a relationship between participation and effective learning. The study also showed that the characteristics of the various cognitive and individual learning styles of students correlated to the teaching method used during the experience.

METHODOLOGY

Action research designs have applied focuses and uses either qualitative or quantitative methods for data collection. Action research can help instructors provide students with more impactful learning. The College of Agricultural Sciences can benefit from active learning by creating a well-rounded, optimal proficiency, and welcoming educational system by creating positive experiences. Action research is designed for educators to address or improve education by studying prevalent issues or problems they face. While this study did not follow the action research design completely, the study did mimic its approach to data analysis and reporting.

This study was designed to understand the importance and capabilities of active learning in the classroom as a possible solution to the issues of college student's depleted test scores and retention, motivational loss, hesitancy for enrollment, and possible discord that arises from insufficient learning. Active learning again is considered, student's active participation, during laboratory. Action research is used when a specific educational problem needs to be solved. This problem may be the problems part-time faculty may face. Learning whether problem-based learning is superior to traditional lecture teaching methods can affect efficiency and depth of what is being taught. Faculty and students alike face the issues within educational institutions that can benefit from incorporating active learning.

This study uses descriptive statistics for analysis. Practical action research focuses on studying local practices, teacher development, student learning, and the possibility of implementing a plan of action. The data offers information about the context and setting of the College of Agricultural Sciences at Colorado State University and its implications with experiential learning. The purpose of using quantitative methods is to provide statistical backing

which will be interpreted to offer a comprehensive picture of the implementation process regarding active learning in the classroom.

Animal Sciences 101 is an introductory course that includes two lectures per week and one laboratory meeting a week. The course is designed to introduce students to the broad field of animal sciences and its many industries. The course is also designed to help students develop an appreciation and understanding for the importance of livestock and meat industries. The course objectives include facilitating learning so students can develop a basic understanding of terminology that is used frequently, grow to understand the "value" of animals and their products and how they are used. Many of the students in this introductory course come from non-agricultural backgrounds, they are typically freshman and sophomores, many of them come from California and there are a few international students every semester.

There will be three years, or six semesters worth of data collected from the Introduction to Animal Science course offered at Colorado State University. Four exams are given throughout the semester which will provide the quantitative data for student productivity with relation to active learning. Methods of data collection for the quantitative research will be course surveys, attendance records, quiz scores, and exam scores. The numeric scores will be used to compare the implications of active learning for the various semesters. Quantitative data is then analyzed for frequency and the two sets are then compared and interpretations can thus be made.

FINDINGS

Colorado State University abides by the traditional grading scale. The level of satisfaction for coursework will be analyzed by comparing the averages to the traditional grading scale. The following figure displays the scale and appropriate percentiles according to CSU's grading mode and Dr. Cunningham's grading scale from her syllabus.

Table 1.0

Grading Scale

A= Excellent	A- (90-92)	A (93-98)	A+ (99-100)
B=Good	B- (80-81)	B (82-86)	B+ (87-89)
C=Satisfactory		C (70-76)	C+ (77-79)
D=Unsatisfactory		D (60-69)	

Throughout the six semesters the three to five-hour exams were 40% of student's final grade. The final exam was worth 15%, lecture quizzes and homework were 10%, iCEV was 10%, and laboratory was 25%. The laboratory grade was broken out further into 50% being quizzes and homework. The other 50% was based on laboratory attendance and participation.

The laboratory sections covered fourteen weeks and included the following subjects: breeds, animal products, animal behavior, anatomy and physiology/growth and development, nutrition, reproduction, poultry, animal health, beef cattle, dairy cattle, sheep and goats, swine, and equine. Laboratories have been transformed and we made changes to what and how things were being taught. Those changes are included in the following sections which include student data in tables, which reflect lecture and laboratory information, course structure, and general curriculum.

Findings for Research Question 1: How does class size affect student performance?

Class size did not have an affect on student performance. According to Iryna Johnson who conducted a study on class size affects on undergraduate student performance, class size does impact student performance in that smaller class sizes are more effective for students. This study showed otherwise. Fall semesters, which had nearly three times the student population, resulted in higher final class scores than the Spring semesters with a notably smaller population of students.

Findings for Research Question 2: How does attendance affect student performance?

Attendance does affect student performance, in that being present in lecture and laboratory accumulated to 10% of the student's grade. Semesters which used consistent measurements of gathering attendance resulted in higher attendance scores. However, the final semester of Spring 2019 shows the highest rate of attendance for laboratory with a lower overall score on laboratory quizzes and overall final course scores. This shows that although student's may be attending their lectures and laboratories, they aren't necessarily participating and retaining the material presented.

Attendance does impact student performance, when students are required to be present, or rather there is an assured incentive of gaining points through attending consistently throughout the semester. Attendance scores showed that active learning in the form of participation does impact student performance. The semesters in which attendance and participation were separate grades, students performed better in general according to their final class scores. In other words, when active learning/participation was a requirement, the data showed attendance improving as active learning was implemented.

Findings for Research Question 3: How does participation affect student performance?

Participation does affect student performance. Student's performance improved when participation was used as a contributor to student's final scores. Students also showed that along with using a point system as an incentive towards attendance and participation, the same goes for utilizing the web resource, iCEV. When students were aware of the weight of completing iCEV assignments they were more motivated to do so. The data shows this from Fall 2016 when iCEV was implemented, but only worth 24 points towards the student's final course grade. When iCEV weights increased, student participation increased, as the score had a heavier impact on final class scores and overall student performance.

Table 1.1

Fall 2016 Lecture and Laboratory Percentile Comparison

Laboratory Quiz Average	Laboratory Attendance	Lecture Quiz Average	Lecture Exams	Final Exam	iCEV	Lecture Assessments of knowledge
86.04%	95%	88%	79%	83.64%	64%	90%

The lecture quizzes given during the Fall semester of 2016 were put in place to gage student progress and their retention with regards to lecture material. Three lecture exams were given during this semester along with a final exam and two assessments of knowledge. The quizzes resulted in a maximum average on the second quiz of 92% The lowest average for the lecture quizzes was quiz number four resulting in a 75.32%.

Three lecture exams were given throughout the semester in combination with an optional final exam for students who had an "A" in the course prior to the final. The final exam was cumulative covering fifteen weeks of material from laboratory and lecture. The final exam resulted in an average of 73.14%. The assessments of knowledge had higher averages than all

four of the exams given. Fall semester of 2016 was the initial year that I was brought in as a teaching assistant.

The course structure, curriculum, and teaching methods were already created. This was the base from which changes were made going into future semesters. Again, for this semester we need to consider that the final exam was optional thus 75 out of 145 students took the final because they had an "A" prior to the final and elected to not take it. The class average for the final exam was 83.64%. Compared to the traditional grading scale used by Colorado State University students are above satisfactory and displayed they understood the material delivered. "Attendance and participation are important components of this course and are crucial for learning. Attendance was expected. By attending both lecture and laboratory regularly, you are setting yourself up for potential academic success in this course" (Cunningham, 2017). The syllabus goes on to state that "attendance is encouraged--There will be NO make up for the laboratory portion of this course" (Cunningham, 2017). At this point lecture and laboratory attendance were randomly chosen days where sign in sheets or assignments went towards student's laboratory grade.

iCEV was introduced during this semester as a trial run for an online learning platform which was required for this semester's course. Videos, reviews, quizzes, and modules were provided in this online platform that students were to use as reinforcement material for their lecture and laboratory material. iCEV offers a stand-alone curriculum resource or supplement resource that was customizable to Animal Sciences 101. iCEV was credited at lower points for this semester than any other with students being able to gain 24 points total.

Laboratory attendance resulted in an "excellent" percentile of 95.2%. Attendance was analyzed through 12 laboratory quizzes and 1 laboratory homework assignment. Sign-in sheets were not used during this semester to gage attendance.

Spring 2017

Table 1.2

Spring 2017 Lecture and Laboratory Percentile Comparison

Laboratory Quiz Average	Lecture Quiz Average	Lecture Exams	Final Exam	iCEV	Lecture Assessments of knowledge
90.85%	86%	79.56%	82.48%	81.76%	93.4%

The semester of Spring 2017 resulted in a lower final exam average than the previous semester by less than 1.5%. The final exam average for Spring 2017 was an 82.48% compared to Fall 2016 at 83.64%. However, the average for iCEV jumped by 17.63%, a notable increase. The points possible for iCEV was increased in Spring 2017 from 24 points possible to 100, giving it heavier weight. Three lecture quizzes along with three laboratory quizzes were given throughout the semester covering individual topics of the week. Laboratory consisted of fourteen weeks of material, where three laboratory quizzes were given throughout the semester. The laboratory quizzes covered material on livestock breeds, animal products, and animal handling and behavior. Students had an average final score of 84.33% between the three quizzes which in total were worth 57 points.

Fall 2017

Table 1.3

Fall 2017 Lecture and Laboratory Percentile Comparison

Laboratory Quiz Average	Laboratory Attendance	Lecture Quiz Average	Lecture Exams	Final Exam	iCEV	Lecture Assignments Average
92%	88.25%	80%	82%	77.19%	82.55%	84.21%

Three changes were made to this semester's design. First, we introduced a section on the "Introduction of Meat and Food Science" to give students information on the broad field of animal sciences and to assist them in developing an appreciation for the importance of livestock and their individual industries they are studying for. Students did well and averaged 88.27% with a possible 135 points possible. iCEV was used again this semester as an online platform where students could earn up to 100 points, the average score was 82.55% which was an increase from the previous two semesters. Second, there were six lecture quizzes given this semester, which was twice as many as the previous semester, where students had an average score of 80% compared to last semester's average of 86%. The laboratory assignments final score average was 90.81%, showing an above average level of participation. The final class average resulted in an 84.39% with 165 students attending. Using the traditional grading scale, this final average was good on the way towards "excellent."

Spring 2018

Table 1.4

Spring 2018 Lecture and Laboratory Percentile Comparison

Laboratory Quiz Average	Laboratory Attendance	Lecture Quiz Average	Lecture Exams	Final Exam	iCEV
95%	92%	84.15%	84.39%	83.75%	88.69%

The laboratory quiz average for this semester was a 94.6% which included three quizzes covering breeds of livestock, animal products, and animal behavior & handling. Laboratory

attendance and participation was gathered through laboratory assignments and random sign-in sheet days. Overall laboratory attendance and participation for Spring semester 2018 was 92%, while student's average final score for laboratory assignments resulted in 88.69%. Compared to the Fall semester of 2017 where students average final score for laboratory assignments was 90.98% and 88.25% for the average attendance and participation. A lower average in laboratory assignments, yet an increase in average attendance and participation.

Fall 2018

Table 1.5

Laboratory Quiz & Homework Average	Laboratory Attendance & Participation	Lecture Quiz Average	Lecture Exams Average	Final Exam Average	Lecture Quizzes & Homework Final Score Average	Lecture Atten-dance	Final Class Score Average
89.69%	92.06%	75.62%	76.95%	77.50%	79.96%	99%	81.61%

Fall 2018 Lecture and Laboratory Percentile Comparison

In the Fall semester of 2018, we made three significant changes. We included an Introduction Terminology Table, Reproduction Homework Assignment, and we also took note of seven lecture days where we had students sign in for attendance. Students were not aware of the days we would be giving attendance points, however we made it known that there would be several opportunities in laboratory and lecture that could not be made up after or outside of class. The seven-attendance sign-in sheet days for lecture resulted in an average of 82.58%. The average score for the lecture exams resulted in a 79.96% while the average for the final exam was 77.5%.

Laboratory attendance was gathered throughout the semester, where we covered major curriculum, and had sign-in sheets or worksheets for students to count as attendance. Laboratory attendance and participation were worth 10 points for each of the days listed equivalating to 100 points total, which resulted in an average of 92.06%, laboratory quiz and homework class average are 89.69%, and the final exam average for this class was 77.5%, resulting in a final class score average of 81.61%.

Spring 2019

Table 1.6

Spring 2019 Lecture and Laboratory Percentile Comparison

Laboratory Quizzes Class Averages	Laboratory Attendance Average	Laboratory Participation Final Score Average	Lecture Quizzes Class Averages	Lecture Exams Final Score Average	Final Exam	iCEV Final Score Average	Final Class Score Average
88.62%	96.5%	90.16%	71.15%	77.13%	74.78%	70.92%	83.39%

The final semester of Spring 2019 focused on iCEV, making the assignments and quizzes required by a deadline for students. The final iCEV average resulted in a 70.92%. The final exam class average resulted in a 74.78%, and all students were required to take the final. The final exam average and the lecture exams average scores for this semester are 74.78% and 77.13%. These averages are lower than any of the previous semesters by .37%-7.26%.

Laboratory attendance was gathered through multiple attendance sign-in sheet days along with group worksheets, and laboratory quizzes. The final laboratory participation score average was compiled of all laboratory activities, sign-in sheets, and quizzes and resulted in an average of 90.16% which was 1.98% lower than the previous semester of Fall 2018.

iCEV was worth substantially more points during this semester compared to all previous others. The initial semester of this study, Fall of 2016, began with iCEV being worth 24 points. This semester there were 27 iCEV modules/assignments/videos that were required and were worth 100 points each, equivalating to a total worth of 2700 points. The final average score for iCEV was 70.92%. The average final score for attendance and participation resulted in an average of 90.16% and standalone attendance averaged 96.5%.

Semester to Semester Averages Comparison

This section will provide a breakdown of changes going through the semesters. This data was used to make comparisons from lecture to laboratory and from semester to semester. The data will reflect what was done throughout the semesters and how the changes impacted overall course grades.

Table 2.0

Laboratory Quizzes

Laboratory Sections	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019
Laboratory Quizzes Class Averages	86.04%	90.85%	92%	95%	89.69%	88.62%

Spring semester of 2018 resulted in the maximum-class average for laboratory quizzes at 95%. Three laboratory quizzes were given during this semester on breeds of livestock (40 points possible), animal products (10 points possible), and animal behavior and handling (7 points possible). Students averaged 97.7% on quiz one, 84.3% on quiz two, and 91.57% on quiz three. The lowest of which being animal products, which was still above CSU's "good standing" grading scale.

The initial semester of this study, Fall 2016, provided the lowest results for laboratory quizzes. The class average was 85.45%. which was still in "good standing" however, the class average was still 9.55% lower than Spring semester of 2018.

Table 2.1

Laboratory Attendance

Laboratory Sections	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019
Laboratory Attendance Class Averages	95%	84.33%	88.25%	92%	92.06%	96.5%

Spring semester of 2019 resulted in the maximum average for laboratory attendance at 92%. During this semester there was consistent laboratory attendance collection for every laboratory. Fourteen weeks of laboratory sign in sheets worth 10 points each making sign-in attendance worth 140 points. Laboratory participation was worth 100 points while laboratory quizzes and homework had 110 points possible.

Laboratory participation for spring 2019 had an average of 90.16% while, laboratory quizzes and homework averaged 85.4%. The lowest average for laboratory attendance was Spring semester of 2017 with an average laboratory attendance of 84.33%. This semester varies from Spring 2019 in that there wasn't a consistent measurement of participation and attendance for Spring 2017.

Table 2.2

Lecture Quizzes

Lecture Sections	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019

Lecture Quiz Class Averages	88%	86%	80%	84.15%	75.62%	71.15%

Fall semester of 2016, the initial semester for this study, had the maximum average for lecture quizzes at 88%. Students averaged highly with 93.39% and 93.41%. These may have impacted quiz scores. The final semester, Spring 2019, resulted in the lowest average for lecture quizzes. Student's didn't meet course standards as an average on quiz three reproduction which resulted in 66.87%. Lecture quiz averages for Spring semester of 2019 were 16.85% than the initial semester of Fall 2016.

Table 2.3

Lecture Exams

Lecture Sections	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019
Lecture Exams Final Score Averages	79%	79.56%	82%	84.39%	76.95%	77.13%

The Spring semester of 2018 resulted in the maximum average score for lecture exams at 84.39%.Students performed best on exam three part two with an average score of 89.4%. While students performed poorest on exam two with an average of 79.51%. Comparing these scores to CSU's traditional grading standards students are performing at a satisfactory level.

Table 2.4

Final Exams

Lecture Sections	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019
Final Exam Final Score Averages	83.64%	82.48%	77.19%	83.75%	77.50%	74.78%

The Spring semester of 2018 had the maximum average for final exam scores at 83.75%. The final exam was worth 15% of the student's final grade. The final exam was comprehensive and was required for all students for Spring semester 2018. The overall goal with multiple quizzes and exams was to provide each student with as many opportunities to succeed academically as possible in the course. A final review guide was offered during this semester in addition to review sessions held by TA's, myself, and Dr. Cunningham (open office hours).

The Spring semester 2019, the final semester, reported the lowest average for final exam scores at 74.78%. Review sessions outside of class were not offered in the final semester nor were optional recitations. The average was also lower than the previous Fall semester of 2018 by 2.72%.

Table 2.5

Assessments of Knowledge

Lecture Sections	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019
Assessment of Knowledge Class Averages	90%	93.4%	N/A	N/A	N/A	N/A

The Spring semester of 2017 varied from the previous semester in that one assessment of knowledge over solely reproduction was used rather than two assessments. The reproduction assessment for this semester was out of 65 points and students averaged a 93.4%.

Table 2.6

iCEV Scores

Lecture Sections	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019
iCEV Final Score Class Averages	64%	81.76%	82.55%	88.69%	N/A	70.92%

The Spring semester of 2018 had the maximum average iCEV score at 88.69% compared to the lowest average from Fall 2016 at 64%. Fall 2016 iCEV was out of a possible 24 points while Spring 2018 was out of 100 points. The iCEV program was pulled in Fall 2018 and reintroduced in Spring 2019 where the points were worth 2700 points, significantly greater than the point value from any prior semester. Spring 2017 and Fall 2017 report similar scores for iCEV at 81.76% and 82.55%, they were both consistent in requirements and points possible (100).

Table 2.7

Final Class Scores

Lecture Sections	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019
Class Pop. Size	145	37	145	42	141	35
Final Class Score Averages	86.63%	76.41%	84.39%	83.19%	81.61%	83.39%

Final class scores showed that the first semester of this study, Fall 2016, had the maximum final class score average at 86.63%. This resulted in a B to B+ for the overall class average grade. The lowest performing semester based on final class score averages was the Spring semester of 2017 with an average of 76.41%. This resulted in a C to C+ for the overall class average grade. Both semesters performed at a satisfactory level however there was almost an entire letter grade difference between the two, the semesters have an overall class grade

average difference of 10.22%. The semester with the maximum average had 145 students in their class while the semester with the lowest average had a total of 37 students.

Fall 2016 resulted in the maximum final class score average. It should be noted that the final exam was optional for this semester for students who had earned an "A" in the course prior to the exam. Out of the 145 students enrolled in the course, 75 took the final. The lowest average final class score was presented in the Spring semester of 2017 at 76.41%.

Table 2.8

Semester to Semester Lecture Average Comparison

Lecture Sections	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019
Class Size	145	37	145	42	141	35
Lec. Quiz	88%	86%	80%	84.15%	75.62%	71.15%
Lec. Exam	79%	79.56%	82%	84.39%	76.95%	77.13%
Final Exam	83.64%	82.48%	77.19%	85.75%	77.50%	74.78%
Assessment of Knowledge	90%	93.4%	87.62%	N/A	N/A	N/A
iCEV	64%	81.76%	82.55%	88.69%	N/A	70.92%
Final Class Score	86.63%	76.41%	84.39%	83.19%	81.61%	83.39%

Student performance was not directly related to class size. For Fall semester of 2016 lecture and lab were organized in one single large group with 145 students. This semester still proved to have the maximum final class score as well as scoring the maximum for lecture quizzes. Fall semester undoubtedly had significantly more students than Spring semesters, yet two out of three Fall semesters had the maximum-class score outcome. Fall 2016 I was a student and in Fall 2017 I was a TA. The two groups were organized differently for lab structure, where Fall 2016 was one large group and Fall of 2017 had two groups. Showing that large class sizes don't necessarily produce lower test and final class scores. A reason as to why these semesters

had the maximum scores could possibly be connected to the final exam being optional for students who already had a previous A in the course.

Table 2.9

Semester to Semester Laboratory Average Comparison

Lab Sections	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019
Lab quiz	86.04%	90.85%	92%	95%	89.69%	88.62%
Lab Attendance	95%	84.33%	88.25%	92%	92.06%	96.5%

The attendance practices for the six semesters, were not organized and gathered in the same way. The findings show that the final semester, Spring of 2019, had the maximum laboratory attendance outcomes, while students still performed above average on the quizzes for this semester as well. Attendance in this section was gathered over 15 weeks' worth of sign-in sheets, class quizzes, and assignments. Spring of 2019 had the maximum laboratory final attendance outcomes, while student performance on lab quizzes was not the maximum in comparison to the rest of the semesters.

CONCLUSIONS AND IMPLICATIONS

The purpose of this study was to explore how attendance, participation, class size, and incentives affect student performance. The analysis of the animal science course on the various teaching techniques impact has the potential to impact agricultural educators and students in the College of Agriculture at Colorado State University by comparing a single course's lecture and laboratory sections.

Table 3.0

Semester to Semester Lecture and Laboratory Intervention Score Comparisons

Lecture & Laboratory Sections	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019
Lec. Quiz	88%	86%	80%	84.15%	75.62%	71.15%
Lec. Exam	79%	79.56%	82%	84.39%	76.95%	77.13%
Final Exam	83.64%	82.48%	77.19%	85.75%	77.50%	74.78%
Assessment of Knowledge	90%	93.4%	87.62%	N/A	N/A	N/A
iCEV	64%	81.76%	82.55%	88.69%	N/A	70.92%
Lab quiz	86.04%	90.85%	92%	95%	89.69%	88.62%
Lab Attendance	95%	84.33%	88.25%	92%	92.06%	96.5%
Final Class Score	86.63%	76.41%	84.39%	83.19%	81.61%	83.39%

Overall Fall semesters, regardless of class size, still performed better with general overall final class scores. Attendance scores showed that active learning does impact student performance. The data supports this statement by showing that when attendance and participation were included in the overall course scores, student's were incentivized to attend and participate in laboratory. The data represented shows that incentives of iCEV and attendance impact student performance. When required to attend or when students are aware that attendance will be collected continuously throughout the semester, attendance increased. Overall class did not impact student performance. The data supports this by showing Fall semesters, which had close to triple the amount of students, still performed higher than Spring semesters.

Table 3.1

Semester to Semester Lecture and Laboratory Attendance Comparison

Semester	Lecture Attendance	Lab Attendance
Fall 2016	88%	95.2%

Spring 2017	85.82%	90%
Fall 2017	84.21%	88.25%
Spring 2018	83.26%	92%
Fall 2018	76.14%	92.06%
Spring 2019	86.79%	96.5%

The first research question reflected on class size effects on overall student performance. Laboratory results showed that student participation and attendance were more consistent than in lectures. Showing that students to some degree value the active experience of laboratory. The challenge now is how to incorporate more participatory methods of active learning in the course. Fall semester of 2016 had one of the largest class sizes with 145 students where students were in one large group for both lecture and lab. Looking at Fall semester of 2017, which also had one of the largest class populations of 145 students, was formatted differently with lecture being one large group and laboratory being separated into two sections. Both semesters, with over triple class populations, had higher final class scores than other Spring semesters with reduced class sizes.

We can infer then that class size and the set-up of lab (in one group or smaller groups) had little impact on overall student performance. However, we must consider that the final exam was optional in these semesters if students had an "A" in the course prior to the exam. Student performance then relies more heavily upon the perceived incentives of the course and the experience of active learning within laboratory. Future suggestions for improvement in the introduction to animal sciences course would be to incorporate field trips to local farms, guest speakers who work in various areas of agriculture, increased group discussion, and mix and

matching students who have agricultural backgrounds and experience with students who are new to it all. As educators we can increase the social diversity of our courses, increase comfort for students by working with groups, and overall increase engagement within the course.

The second research question in this study is how does attendance affect overall student performance? The results showed that laboratory participation, attendance, and general scores were slightly above lecture. We also discovered that during the final semester of Spring 2019 that by measuring attendance through consistent sign-ins, worksheets, etc. we can increase our effectiveness in ensuring our students are present for both laboratory and lecture. By placing a higher weight on attendance and participation, we are ensuring students are receiving the necessary information and understand that they have a responsibility as a student to be active. A future suggestion might be to incorporate a separate division for the course's participation in laboratory. Where students could have a potential amount of points that they must obtain to finish the semester, which they can gain by engaging.

The final research question involved the effects of participation on overall student performance. By making attendance mandatory and separate from participation, students will potentially place a higher value on being in class, actively participating, and gaining insight that wouldn't otherwise be gained from reading a textbook. Introduction to animal sciences is an experiential based course, making it critical for student to be present and involved. By implementing an attendance policy that consistently is obtained in lecture and laboratory there is enormous potential for student performance to improve simply based on student presence within the experiential learning cycle. Active learning via laboratory affected student performance by incentivizing students to engage within the course.

The findings in this study have the potential to educate instructors on how to diversify and improve their teaching methods, by helping them develop an understanding of the relationship between participation and student performance. While also introducing new knowledge and experience to improve and increase the effectiveness in classrooms on various levels of education.

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