Methods to Evaluate and Predict Student Success in Introduction to Animal Science at Western Kentucky University

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METHODS TO EVALUATE AND PREDICT STUDENT SUCCESS IN
INTRODUCTION TO ANIMAL SCIENCE AT WESTERN KENTUCKY
UNIVERSITY.

A Thesis
Presented to
The Faculty of the Department of Agriculture
Western Kentucky University
Bowling Green, Kentucky

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science

By
Matthew Allan Deppe

August 2002
METHODS TO EVALUATE AND PREDICT STUDENT SUCCESS IN INTRODUCTION TO ANIMAL SCIENCE AT WESTERN KENTUCKY UNIVERSITY

Date Recommended

[Signatures]

Dean, Graduate Studies and Research

Date
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METHODS TO EVALUATE AND PREDICT STUDENT SUCCESS IN INTRODUCTION TO ANIMAL SCIENCE AT WESTERN KENTUCKY UNIVERSITY.

Matthew Allan Deppe August 2002 70 Pages

Directed by: Gordon Jones, Elmer Gray, David Coffey, and Kenneth Stalder
Department of Agriculture Western Kentucky University

Outcomes assessment is the process of determining student progress in a class or academic program. Students, \( n = 306 \), from six freshman-level introductory animal science classes at Western Kentucky University (WKU) were given subjective and objective evaluation instruments on the first and last day of class. Students self evaluated competencies on each of forty-nine course outcomes using a scale of 1-100. Twenty-one demographic questions were also answered. Students were given the same 50-question examination following completion of the subjective assessment on the first and last day of class. Student high school performance measures including the American College Test scores (ACT), percentile rank within class (HSPILE), and high school grade point average (HSGPA) were collected. Dependant variables were average beginning assessment (ABA), average ending assessment (AEA), average improvement (AI), initial test score (ITS), last day test score (LDTS), test improvement (TI), final test score (FTS) and final average (FA). Section, semester, and year effects were also statistically evaluated. Independent variables included hours completed at WKU, student type, gender, lab enrollment, community size, and activities. ACT English score (ENG), ACT math score (MATH), ACT reading score (READ), ACT science score (SCI), composite
ACT score (COMP), HSPILE, and HSGPA were included as linear covariates in the analyses of variables.

Year had a significant effect on ITS (\( P = .0002 \)) and TI (\( P = .03 \)). Accumulated Western Kentucky University hours significantly affected AEA (\( P = .06 \)), TI (\( P = .09 \)), and FTS (\( P = .08 \)) and also approached significance for ITS (\( P = .12 \)) and LDTS (\( P = .13 \)). Student type approached significance for ABA (\( P = .12 \)). Gender significantly affected AEA (\( P = .07 \)). Lab enrollment had significant effects on AI (\( P = .07 \)), ITS (\( P = .008 \)), FT (\( P = .09 \)), and FA (\( P = .01 \)). Community size significantly affected AEA (\( P = .10 \)) and LDTS (\( P = .10 \)). The degree of activity in 4-H or FFA (none, 4-H or FFA, or 4-H and FFA) significantly affected ITS (\( P = .09 \)) and TI (\( P = .02 \)).

Coefficients of correlation between subjective and objective measures in the study show that there was little relationship between subjective and objective measures (\( r < .34 \)). ABA and AI were negatively correlated (\( r = -.84 \)) indicating that students perceived they had gained knowledge in the subjects presented upon their completion of the class.

Coefficients of correlation between pre-college performance measures and student perceptions of knowledge were low (\( r < .14 \)). ITS, LDTS, and TI were moderately correlated with pre-college performance measures (\( r = .02 \) to .36). Results of this study conclude that there is need for developing an assessment tool that implements both subjective and objective measures in order to be more accountable for the material students learn and their opinions of the class.
Chapter 1

INTRODUCTION

Higher education has long been under scrutiny with regard to its accountability for effectively assessing student success in academia and in the job market. This criticism originates from areas outside the institutions such as political pressures and public demands for higher quality, more effective educational environments. Today there are more U.S. citizens who have obtained or are in the process of obtaining college degrees than ever. Therefore, quality educational experiences are more in demand now than at any other time in history. Higher education institutions are obligated more than ever to provide data verifying their ability to meet these demands.

Nation wide, the necessity of a college degree as a means for career success may force some students to enroll in higher educational institutions though not adequately prepared for the more rigorous academics at this level. Usually, these students are required to enroll in remedial classes, which in theory, better prepare them for the higher level classes. To correctly place students in remedial classes, they must be properly identified with pre-college measures (ACT, SAT, HSGPA, HSPILE).

Demographics may also contribute to or be indicative of students’ success in their degree programs. Obtaining demographic information may assist in identifying those who need added assistance within a specific class or perhaps with the overall university environment.

It is higher education’s responsibility to effectively and properly prepare students for careers after graduation. The two basic sources of information used in assessing teaching effectiveness are subjective and objective measures. Subjective evaluation
instruments rely on student perceptions and opinions to evaluate teacher and institutional effectiveness. Subjective instruments are traditionally administered at the beginning, end, or both times in the semester and may not be highly effective predictors of student success. Students often do not have a precise estimation of their level of course related knowledge. These instruments have been used to determine how a student "feels" about the way a professor teaches. Such instruments may not be an effective means for the teacher/professor to understand student needs. However, the subjective measure has utility in assessing students' experiences in a class and for measuring accountability of the institution.

Objectively based assessments traditionally ask students to reciprocate their knowledge of subject matter on tests administered at the beginning and end of the semester. This type of instrument does not provide an accurate estimate of how students "feel" about their academic experience, but may provide a more precise means for professors to identify the subjects that may have been taught effectively and those that were taught ineffectively during the semester. It also may provide students with an appreciation of the information that will be covered on future examinations.

Additional research is needed to compare instruments or their effectiveness for accountability measurement. Additionally, the use of demographic data, applicable to a specific course, to more precisely understand differences in the way students perform has not been thoroughly studied. These objective and subjective testing means may be used in combination to properly identify student potential performance and thereby improve teaching effectiveness. Consequently, the major objectives of this thesis were to
investigate methods used to evaluate and predict outcomes for students in introduction to animal science at Western Kentucky University.
Chapter 2

REVIEW OF LITERATURE

Education at the community college, college, and university levels has been subjected to numerous changes in attempts to educate diverse student bodies. Additionally, educators are expected to address “real-world” applications in today’s society (Casazza, 1995).

What is the purpose of postsecondary and higher education today? Who should attend college? How should the curriculum be developed? How should educational institutions structure their programs toward the preparation of students? Responses to these questions have provided fuel for academic debate as long as institutions of higher education have existed.

**Historical Perspectives**

Educational reform has long been a battle between traditionalists and reformists. Traditionalists are usually defined as those within the system who argue that student enrollment must be more selective if high academic standards are to be obtained (Casazza, 1995). Traditionalists often defend the merits of an established curriculum suitable for everyone and often discredit the institutions that acclimatize their offerings to individual needs of a variety of students. They also tend to charge the individual rather than the institution with the total responsibility for failing or succeeding in their educational ventures (Casazza, 1995).

Reformists, on the other hand, have frequently been outside the system of higher education. Historically, the federal government through its funding policies or legislation has promoted the reformist ideal of granting more access to colleges and universities for
more types of academically diverse populations. Their principal argument is that in a
democracy education is the granted right of every citizen and most certainly a means for
advancement in society. More specifically, the curriculum must be relevant and must
prepare individuals for their role in society. Reformists can be given at least some
measure of credit for the change in the mechanisms that are necessary to facilitate student
success (Casazza, 1995).

Changes in curricular structure can be noted throughout the history of higher
education. In the beginning the early colleges, Harvard and Yale, were focused on
training clergy and preserving and maintaining cultural norms brought from Europe
(Butts and Cremin, 1953). However, the norm did not persist. Gradually, higher
education went from trying to maintain who we once were to opening up minds
concerning new surroundings and studying cultures in the New World. Thomas
Jefferson, for example, at the College of William and Mary in 1779 recommended that
instead of trying to Christianize the Indians through schooling, the college should try to
understand the Indian culture by studying it laws, language, religions, etc. (Butts and
Cremin, 1953). Francis Wayland, President of Brown University, proposed one of the
most democratically influenced missions for colleges of that time. He described college
as the “center of intelligence for all classes” and developed a university extension
division that included classes taught by the faculty of Brown (Brubacher and Rudy,
1976).

Curricular design in the first portion of the 19th century was not directly connected
to an individual’s professional aspiration. It was simply designed to provide the elements
thought necessary for the life of a gentleman. The coursework was borrowed from the
classical tradition focusing on Greek, Latin, and Mathematics. The focus was on discipline of the mind by providing it with difficult material and forcing recitation to prove its effectiveness (Casazza, 1995). In 1837, the debate of curricular design was challenged by Ralph Waldo Emerson, who promoted the idea of “adapting education to the individual” and “developing a distinctively American intellectual culture” (Brubacher and Rudy, 1976).

From 1862 – 1960 the federal government became directly involved in the educational system at all levels. Its influential hand was felt in higher education as a result of several initiatives including the Morrill Acts, equal opportunity legislation, and the G. I. Bill. Also within this time period, the purpose of higher education became more diverse in its programs offered and the missions stated by different universities and colleges (Casazza and Silverman, 1996).

President Abraham Lincoln signed the first Morrill Act in 1862 granting 30,000 acres of land per congressman to be sold for the purpose of funding colleges dedicated to teaching agriculture and the mechanical arts. In 1890, the first Morrill Legislation was followed by a second Morrill Act that reinforced the support for this broader educational mission for African-Americans in southern states (Casazza and Silverman, 1996). Since the late 1800’s further revisions have provided support for other minorities, the latest being the Improving American Schools Act of 1994 and including 29 Native American colleges.

Toward the end of the 19th century, the role of secondary schools was to prepare those students attending for jobs after graduation. At this same time, college officials saw a need for their students in attendance to be better prepared in basic subjects such as
mathematics and science. At this time, there were no entrance stipulations, in the form of
tests, for those transferring into a “four year” institution from high schools or secondary
schools. Without entrance stipulations, secondary institutions had nothing in place to
measure nor to keep in focus their efforts to prepare students for a more specific subject
of study when transferring to an institution of higher learning. As a result, secondary
schools had to show some record of accountability regarding students’ knowledge of
material studied at the secondary school (Casazza, 1995).

In the beginning of the 20th century, as a result of universities voicing the need for
more prepared college freshmen, those attending college were better prepared and more
scholastically successful when attending the university. Several colleges proposed that
student program length could be shortened; thus shorter length programs were developed
so that students were able to complete further study in four years. By the end of the
second decade of the 20th century (1917), the United States had 76 institutions that were
focused on student preparation for liberal arts and professional training (Casazza, 1995).

The student body increased not only as a result of improved and expanded areas
of focus, but from other efforts as well. The G.I. Bill of Rights is just one example.
National heroes were returning from World War II; the new Bill, written with the
assumption that few would take advantage of it, inspired more than one million veterans
to enroll in higher education by the fall of 1946 (Wyatt, 1992). These more adult
students created a different atmosphere on the traditional college campuses. The overall
student body changed dramatically because most of those taking advantage of the G. I.
Bill were from the middle or lower class, married, and often the first in their family to
attend college (Maxwell, 1979).
Curricular design appropriate for meeting the needs for a changing student body was problematic for this time period. In 1879, a fifty percent failure rate on entrance exams led to Harvard’s implementation of extra assistance to prepare students for college-level classes (Weidner, 1990). Still, by 1907, many newly admitted students did not meet entrance requirements (Wyatt, 1992). To combat this persistent problem, schools added developmental courses to their curricula for remedial math, reading, science, etc. Many studies were conducted to accurately determine reading ability, and remedial classes were established to help students perform better in higher level classes. In 1948, William S. Gray called for college reading to be taught to all students (Wyatt, 1992).

In the early sixties the educational system experienced even more controversy from one main group of educational leaders and theorists. This group represented those who believed that education beyond high school was a right and not a privilege. Flexibility was addressed and dealt with as institutions began to recognize that the life styles and special circumstances of students had to be accommodated. Classes were held during day and night hours. Legislation was passed to accommodate and encourage those who had not been grouped into the traditional student population to attend college. The Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 further legislated “non-traditional” students into pursuing their education (Casazza, 1995).

Around the nation’s campuses gender gaps were changing. More women were going to college. By 1973, more than one thousand Women’s Studies courses were offered (Casazza, 1995). Furthermore, classes targeting ethnicity and cultural diversity began to appear on more of the nation’s college campuses (Casazza, 1995).
Learning Styles

From higher education’s inception, scholars have studied the psychology of learning - how people think, learn, and comprehend. A number of psychological researchers were interested in learning theory; through their work, a notable body of research and scholarly activity was conducted up to the 1960’s. Four of the most influential contributors are Imanuel Kant (1724-1804), E. C. Tolman (1886 – 1959), Benjamin Bloom (1913 – 1999) and Herman A. Witkin (1916 – 1979).

Kant, a philosopher, postulated that mental representation requires both concepts and sensations (intuitions). Discrimination not only requires one to assimilate information but also to develop that ability to discriminate. Kant expressed some striking ideas concerning self-awareness, one form of consolidated consciousness. We are aware of ourselves as the single common subject of our representations. Kant is credited as the initial theorist, in the modern era, who perceived the mind as a system of conceptual functions, converting perceptions into mental representations. He saw the mind as an array of segments used to synthesize perceptions based on outside referents. To understand his theory, imagine a computer as an assembly of parts that, when put together in a specific way, works as a machine in our every day lives. He was also the initial philosopher to suggest that we cannot know what the mind is like, not even something as basic as knowing whether it is simple or complex. He argued that we cannot infer how the mind is constructed by the way in which it functions. “Function does not determine form.”

Kant urged that to represent the world, two kinds of synthesis must be performed. First colors, edges, textures, etc. must be synthesized into representations of single
objects. Then the various represented objects must be tied together into a single representation of a world. For example humans don’t see a red object and immediately know that it is an apple. They must also visualize the shape and texture. Kant’s “unity of consciousness” represents our ability to be aware of a great many things at the same time, or better, as parts of a single global representation (Microsoft® Encarta® Online Encyclopedia, 2000).

Tolman, an American psychologist, made significant contributions to the study of learning and motivation by creating a cognitive theory of learning. Tolman perceived learning as developing from bits of knowledge and cognitions about the environment and the relationship of the organism to it. This theory contrasted to the theories that espoused learning as a strict stimulus-response connection (Kimble et al., 1991).

Tolman used rats to study the role that reinforcement plays in the learning routes through complex mazes. From these experiments, he postulated the theory of latent learning which describes learning that occurs in the absence of an obvious reward (Barker, 1997). The first experiment using the paradigm of learning without reward was tested in 1929, using three groups of rats trained to run a maze. The control group was fed upon reaching the goal. Points at which the rats were rewarded were varied in the other two groups by not rewarding at first, but then at a particular day the rats found food at the end of the maze. The first group was rewarded on day seven during the study and the second group was rewarded on day three and thereafter. Both experimental groups demonstrated diminished errors when running the maze the day after the transition from no reward to reward conditions. This observable performance continued throughout the rest of the experiment, suggesting that the rats had learned during the initial trials of no
reward and were able to use a "cognitive map" of the maze when the rewards were introduced. Tolman referred to the initial learning that occurred during the "no reward" portions of the experimental trials as latent learning. He postulated that humans engage in this type of learning everyday as we do things we have done for a lengthy time. An example of latent learning is driving or walking the same route daily and learning the locations of various buildings and objects. One pays no attention after taking a route to a destination several times. Only when finding the building becomes a necessity does learning become obvious. Tolman’s latent learning theory received much controversy, but several investigators demonstrated that rats do learn in the absence of rewards (Hothersall, 1995).

Cognitive learning is demonstrated by knowledge recall and the intellectual skills: comprehending information, organizing ideas, analyzing and synthesizing data, applying knowledge, choosing among alternatives in problem-solving, and evaluating ideas or actions. Bloom (1956) headed a group of educational psychologists who developed a classification of levels of intellectual behavior important in learning and published their theories in *Taxonomy of Educational Objectives: The Classification of Educational Goals: Handbook I, cognitive domain*. Bloom used verb examples defining the major categories in the cognitive domain of the taxonomy of educational objectives to represent intellectual activity on each level as listed below:

1. **Knowledge**: arrange, define, duplicate, label, list, memorize, name, order, recognize, relate, recall, repeat, reproduce, state.
2. **Comprehension**: classify, describe, discuss, explain, express, identify, indicate, locate, recognize, report, restate, review, select, translate.
3. Application: apply, choose, demonstrate, dramatize, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use, write.

4. Analysis: analyze, appraise, calculate, categorize, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, test.

5. Syntheses: arrange, assemble, collect, compose, construct, create, design, develop, formulate, manage, organize, plan, prepare, propose, setup, write.


In 1962, Witkin further separated cognitive style into two types of learner categories with his “Field Independent-Dependent” theory of cognitive learning style or the manners in which individuals best learn subjects. He believed that learners were either field-dependent or field-independent (Witkin et al., 1962). According to Witkin and coworkers (1962), cognitive style is a self-consistent mode of functioning in which individuals show their perceptual and intellectual activities (Witkin et al., 1962). Field-dependent individuals rely on external referents as guides in information processing whereas field-independent persons tend to give more credit to internal referents.

In his theory field-independent learners:

1. Make greater use of meditational processes such as analyzing and structuring.

2. Adopt an active, hypothesis-testing role in learning.

3. Are less dominated or governed by the most obvious or salient cues in learning.
4. Operate more from internally defined goals and reinforcements and thus are more likely to be motivated by intrinsic or task-oriented forms of motivation.

He defined the field-dependent learners as those who possess the following characteristics:

1. Make less effective use of the meditational process.
2. Adopt a passive, spectator role in learning.
3. Are more dominated by salient cues in learning.
4. Are better at learning and remembering information having social relevance or content.

Witkin et al., (1971) devised a perceptual test that requires an individual to locate a simple figure within a larger complex figure and labeled it the Group Embedded Figures Test (GEFT). The GEFT is composed of 18 complex figures and scores range from 0 to 18. The number of correctly found simple shapes is reflected in the GEFT score (Whittington and Raven, 1995). The national mean is 11.4 (Witkin et al., 1971). Those individuals who score above 11.4 are considered field-independent and those who score below are considered field-dependent.

In the late 1970’s, studies showed that field-independent learners tended to major and graduate with science and math type majors whereas field-dependent learners tend to major in educational and social sciences (Witkin et al., 1977). With these studies, further investigation focused on the classroom instructors' abilities to effectively teach toward both learning styles.

In agriculture courses, some investigation has also been reported. Honeyman and Miller (1998) used the GEFT to categorize student learning styles in a senior level
collegiate pork production course. They studied how different teaching methods used in the three accompanying laboratory sections affected student performance. One laboratory addressed learning styles of field-dependent learners with emphasis on student role playing, consensus building, and team reports. The instructor provided recurring positive feedback to students, led discussions, and highlighted information. In another laboratory individual student competitions, individual reporting, and individual defense of opinions was incorporated for the field independent learners. The teaching approach, in contrast to the field-dependent lab, emphasized reduced positive feedback, recognition of individual student efforts as much as possible, use of voting to decide issues, and limited teacher-student comments where only students' questions were answered. Finally, a combination of methods were established and used in the third lab to identify if it was possible to teach towards both learning groups successfully.

They found that a combination of teaching methods suited to field-dependent and field-independent learners was most effective for students involved in their study. They demonstrated that it may not be necessary to tailor instruction to the students' learning style preferences. Furthermore, they suggested a more practical and effective approach to select a combination of teaching methods suited to both styles on a consistent basis.

In a related study, Hoover and Marshall (1998) found that a majority of students enrolled in selected animal science courses were more field-independent (58%). They suggested instructional strategies that facilitate the learning for all students by using a variety of instructional strategies.
Outcomes Assessment

Teaching has been considered the act of transferring information from the instructor to the learner, an empty vessel to be filled with knowledge. College teaching traditionally has been conducted via the lecture method, where knowledge is transmitted from professor to students. The students passively receive information. The emphasis in this style of teaching is on acquisition of large amounts of information, sometimes outside the context in which it will be used (Cross, 1998). Research has shown that traditional, teacher-centered methods are not totally ineffective. However, the evidence is abundantly clear that conventional methods are not as effective as some other far less frequently used methods (Terenzini and Pascarella, 1994). In fact, the lecture method has been shown to be less effective than other methods in changing thoughts and attitudes (Bligh, 1972). These findings suggest that a change in the traditional method of collegiate teaching is needed in order to enhance student learning (Kellogg Commission on the Future of State and Land-Grant Universities, 1997 and 1999). The current philosophy in higher education is that focus should be on student learning, rather than teaching to improve students’ collegiate educational experiences (Cross, 1998).

Focusing on learning rather than teaching requires that educators rethink their role and the role of students in the learning process. Faculty tend to view the primary obligation of the university to students to be the development of intellectual independence (Baird, 1988; Barzun, 1993). They focus on criteria such as the ability to think critically (Barnett, 1988; Trice and Dey, 1997). On a higher level, the university’s optimal goal is usually focused on professional job attainment of graduates after
completion of a degree. Students and universities share a common goal of completion of the degree and securing employment.

With the goals of the various groups involved within higher education, institutional accountability to the students is a major focus that universities need to address. However, at the same time assessment needs to be used within the various academic focuses of an institution as a means to accurately estimate where institutions stand as compared to their goals. Frequently, self assessment of universities and their various academic departments is undertaken in response to external authorities who expect clear, ratified criteria to be used in the accountability process (Heller, 2001). These external authorities are usually governmental and / or the general public who demand accountability from institutions of higher education. This need for accountability has steadily increased over the past decade (Brennan et al., 1999). As interest in the topic of assessment has increased nationwide, universities are making their goals and accomplishments publicly known. But, now they have tangible evidence of their accomplishments.

To be both valid and useful, the assessment approach taken must be aligned or consistent with the goals of the institution or department; assessment results must be credible and unrivaled. The criteria on which an assessment is based should be understood by the larger community (Heller, 2001). Outcomes normally measured include: knowledge; skills----basic, higher order, and career related; attitudes and values; and behavioral outcomes---- what students do during and after college or university (Heller, 2001).
In 1997 Skaar and Kenealy reported that Iowa State’s Department of Animal Science reviewed its undergraduate program in an effort to address the increasingly diverse needs of students. The need for this review became apparent from student surveys, faculty observations, and employer comments. Specifically, a decrease in pre-college animal experience, a decline in those students interested in production careers, and an increase in those students interested in science and business was observed (Skaar and Kenealy, 1997). Ten major educational outcomes were devised for the specific program with over 300 learning experiences that would serve to meet student needs. The redefined curriculum included revision of course titles and objectives. Courses were sequenced into a four-year plan that was defined by learner competencies related to the cognitive levels of learning expected for the courses. Cognitive learning skills were examined to ensure that higher skill levels were promoted in upper level courses. As a result, the Animal Science Department at Iowa State now offers a total of 53 courses within the program. Twelve new courses, emphasize “working with animals” and animal management. Fifteen courses received “major restructuring” to match program outcomes (Skaar and Kenealy, 1997).

**Performance Testing**

Many researchers agree that building on what is already known is considered good educational practice, and the benefits of assessment prior to teaching have been well documented (Hewson and Hewson, 1983; Angelo, 1993; Osman and Hannafin, 1994; Benton, 1995; Martens and Dochy, 1997). A relatively easy way to test whether one’s classroom teaching is effective is to actually analyze the students on their knowledge of subjects that are to be discussed in class before the course begins and again at the end of
the semester. After the initial evaluation, a strategic plan for instruction of a class may be used to incorporate topics to be presented, methods of instruction, and the rate and depth of coverage of the selected topics.

Using performance type assessment tests at the beginning and end of each course has several advantages. Pre-testing has been found to increase later test performance. Providing correct answers after pre-tests has shown to increase marks in a later exam when compared with a control group of students who were not pre-tested (Osman and Hannafin, 1994). Pre-testing also provides students with an example of test construction and format and aids students in studying for both the information covered and the manner in which questions are asked. Pre-testing can be helpful in itself by "training" students to comprehend exam formats and conditions (Martens and Dochy, 1997). It also gives the students a somewhat accurate measure of their understanding of concepts and information to be presented within a course. Students may overestimate the extent of their previous knowledge, and tests help students clarify whether prior knowledge can be measured in a meaningful manner (Wratten and Hodge, 1999).

**Predictors of Academic Success**

Institutions of Higher Education have had entrance parameters for admission. Most institutions require a specific class rank, score on the Scholastic Aptitude Test (SAT) or American College Test (ACT), a minimum entrance exam score, a minimum high school grade point average, percentile rank in class, or some combination of these performance indicators. These entrance parameters help university personnel identify those students who may have a higher risk of leaving the university prior to graduation. Student scores have some predictive value to the universities, and a large numbers of
studies have been conducted to determine which values are best indicators of student
academic performance and persistence. Three measures that have been frequently
researched to predict future academic performance are standardized tests, High School
Grade Point Average (HSGPA) and Class Rank. A majority of studies conducted on
predicting academic success encompass student differences such as ethnicity and gender.
Noble et al. (1996) reported that ACT scores slightly overpredict course success for
blacks and males relative to whites and females. When a differential prediction was used
based on standardized test scores and high school grades, Young (1994) found a slight
over prediction of the college GPA's of African-Americans relative to Caucasian-
Americans, and of males relative to females. High School performance has been noted as
the best single predictor of college grade point average (GPA) (Bean and Bradley, 1986).
Chaney and Farris (1991) found that students who had above the mean HSGPA
graduated at a much higher rate than students who had HSGPA below the mean.
Successful students did have higher first semester GPA's and that GPA was correlated
with the composite ACT score (Carney and Geis, 1981).

Several studies found that females obtained significantly higher college GPA's
than males even though their predictor scores (SAT or ACT) were significantly lower
than those of men (Bridgeman and Wendler, 1991; Young, 1991). To explain the under
prediction of females, researchers postulated a small magnitude of the phenomena could
be explained as an artifact of college grading that was unrelated to a student's gender.
Some researchers have reasoned that females major in fields that grade more leniently.
Hewitt and Goldman (1975) reported findings which showed very little residual
difference between the GPA predictions of males and females when the students’ major fields were considered.

Using a single prediction equation for all students, Bridgeman et al. (1999) reported that men tended to get lower grades than predicted and women higher grades than predicted. Similarly males generally performed slightly lower than predicted in their freshman year (Bridgeman et al., 1999).
Chapter 3

MATERIALS AND METHODS

The objective of this study was to assess a method of evaluating student outcomes in Animal Science 140 (ANSC 140) in the Department of Agriculture at Western Kentucky University (WKU). The specific aim was to use results from ANSC 140 as a model for developing outcomes assessment tools for other courses in the Department of Agriculture. A broader more comprehensive goal was to use the results of this preliminary outcomes assessment evaluation to develop a set of departmental outcomes and propose a method of assessing those outcomes for all students in the Department of Agriculture at or near the time of their graduation.

The outcomes for the freshman (introductory) animal science class at Iowa State University (Appendix Table 3) were used as a model for developing a set of 49 outcomes for ANSC 140 at WKU (Appendix Table 1). The 49 outcomes for ANSC 140 at WKU were developed specifically to reflect the goals and objectives of the course. The decision was also made to have students evaluate their competency for each of the 49 outcomes on a scale of 1-100 in an effort to make the scores more continuous in nature. In addition to the students' subjective appraisal of their competence for the 49 outcomes, an objective 50-question multiple choice examination was administered the first day of class and as the first 50 questions on the final examination.

Questions on the 50-question examination were selected from previously administered comprehensive final examinations to specifically address concepts of animal science that were included in the 49 outcomes for the class. Questions were taken from final examinations with Kuder-Richardson reliabilities of greater than 0.80.
A further objective of this study was to determine the value of pre-college academic performance parameters to predict students’ performance in ANSC 140. The parameters considered were American College Test (ACT) scores for English (ENG), mathematics (MATH), reading (READ), science (SCI), and the composite (COMP) score. High school grade point average (HSGPA) and the percentile rank in high school graduation class (HSPILE) were also considered.

Six sections of ANSC 140 at WKU were sampled. Data collection occurred on the first and last day of the each semester (n=306). Students from four fall (1999 and 2000) and two spring sections (2000 and 2001) were sampled. Two sections of the course are offered each fall and one section each spring semester. ANSC 140 is required for students who major in Agriculture. The course is designed to teach practical and scientific principles of animal science and the related animal industries.

The 49 course outcomes were developed by instructors to focus on the curricula of the course and minimum knowledge expectations of the course. Outcomes were compiled using a multi-step “action-plan” similar to methods used at ISU in the mid 90’s to reconstruct their animal science curriculum (Skaar and Kenealy, 1997). A diverse student population representing rural farm and non-farm as well as urban students was recognized. The laboratory that accompanies the course emphasizes “hands on” experiences. Sessions were consistent with topics concurrently presented in lecture. Subject matter included in the course reflected the relative importance of the subjects to students’ success in higher-level courses and in their career goals.

Demographic data were obtained from each participating student. These data were used as independent variables in the statistical models used to analyze the effects of
these variables on assessment estimates, scores on the 50-question examination, final test score, final average, and laboratory grade. These data included questions concerning their place of origin, gender, background, etc. (See appendix Table 2 for a complete list). After data were compiled and labeled according to section, semester, and year they were combined with additional information recorded for each student previously mentioned including ACT scores, HSGPA, and HSPILE.

Many institutions and departments employ Bloom’s Taxonomy when organizing class hierarchy. While the course is introductory and students are primarily expected to perform tasks in the knowledge category in Bloom’s Taxonomy (arrange, define, duplicate, label, list, memorize, etc.) a conscious effort was made to evoke higher levels of cognition as the course progressed. Students were introduced to new subject matter beginning with terminology and later utilizing application, analysis, synthesis, and evaluation.

Data from students who did not complete a full semester in the class were disregarded in order to focus on factors influencing successful completion of the course. However, some students who dropped out of the class were re-enrolled in later semesters to complete the class. Additionally, the question on residency was reduced to include only those students who were domestic-in-state and domestic-out-of-state students. Coefficients of correlation were calculated between pre-college performance measures and assessment measures for those students who had ACT Scores, HSGPA, and HSPILE on file.

Data were analyzed using a fixed model PROC MIXED of SAS (SAS, 2001). Least Squares Means was implemented to estimate arithmetic means due to unequal class
numbers. The model included class variables of accumulated Western Kentucky University hours, student type, gender, lab enrollment, community size, activities, year, semester, and section (Table 4, 11, and 12). Scores and values from ENG, MATH, READ, SCI, COMP, HSPILE, and HSGPA were included as linear covariates in the analyses of independent variables.

PROC CORR of SAS (2001) was used to compute coefficients of correlations among the following variables: average beginning assessment (ABA), average ending assessment (AEA), average improvement (AI), initial test score (ITS), last day test score (LDTS), test improvement (TI), final test score (FTS), final average (FA), laboratory grade, ACT components, HSGPA, and HSPILE. To determine whether coefficients of correlation were numerically different between the genders, PROC CORR of SAS (2001) was also calculated separately for males and females.

In an attempt to predict student final average a multiple regression analysis was conducted using a stepwise procedure. FA was used as the dependent variable; ABA, ITS, HSGPA, ENG, MATH, SCI, COMP, and READ were used as independent variables.
Chapter 4

RESULTS

Data were collected at Western Kentucky University at the beginning and ending of the fall (1999 and 2000) and spring (2000 and 2001) semesters. Students from 6 sections of Animal Science 140 were included. Independent variables collected in the study are presented in Table 4. Differences were calculated between the beginning (ABA and ITS) and the end (AEA and LDTS) of the semester for both subjective and objective based tests. The effects of various demographic parameters on beginning and ending scores as well as differences between scores were evaluated. Additionally, year, section, and semester fixed effects were statistically evaluated.

When the perception-based knowledge estimates were evaluated, several demographic parameters contributed significantly to variation among students (Table 5). Demographic variables that significantly \( (P < .10) \) contributed to student perception score variation included lab enrollment, gender, community size, and current accumulated WKU hours. Variables that were not significant \( (P > .10) \) included section, semester, year, student type, and pre-college 4-H and FFA activity.

Student achievement on the 50 - point test was measured at the beginning (ITS) and end (LDTS) of the semester and test improvement (TI) was calculated as the difference between the two scores. Significant sources of variation \( (P < .10) \) in test scores and improvement included year, current accumulated WKU hours, lab enrollment, community size, and pre-college 4-H and FFA activity, (Table 5).
Effects of year, semester, and section.

Least square means by year, semester, and section for ABA, AEA, AI, ITS, LDTS, TI, FT, and FA are presented in Table 6. No significant year, semester, or section effects were observed for ABA, AEA, or AI. Students in the spring 2001 class had significantly lower ITS than students who completed the course in 1999 and 2000. In addition, the spring 2001 group also made significantly ($P < .10$) more improvement in their test scores than students completing the class in 1999 and 2000. There were no other significant year, semester, or section effects ($P > .10$).

Current accumulated WKU hours

Least squares means for ABA, AEA, AI, ITS, LDTS, TI, FTS, and FA for students categorized by credit hours accumulated at WKU (0-32, 32-64, >64) before they entered ANSC 140 are presented in Table 7. Significant credit-hour group differences were found for AEA ($P = .06$). Students who had accumulated zero to 64 hours had greater AEA scores than students who had accumulated greater than 64 hours before entering the class.

Significant differences were observed among WKU credit-hour groups for TI from the ITS to the LDTS ($P = .09$). However, ITS and LDTS differences only approached significance ($P < .12$ and $P < .13$, respectively). Those students considered freshmen improved to a significantly ($P < .10$) higher degree (12.42 points) than those with more than 64 hours accumulated in the time between the first and last tests. Table 7 also shows that the freshmen (0-32 hours) significantly ($P = .07$) out performed both groups on the final test.
Student type

Students were also asked to identify themselves as domestic out-of-state or domestic in-state students. Least squares means for ABA, AEA, AI, ITS, LDTS, TI, FTS, and FA for students considered domestic-out-of-state or domestic-in-state are presented in Table 8. Differences between these two groups approached significance for ABA ($P < .12$). Students considered domestic out-of-state had slightly higher self-assessment scores than domestic in-state students. These group means were not significantly different ($P > .10$) at the end of the semester. ITS, LDTS and TI between student types were not significant ($P > .10$). The FTS and FA were not different ($P > .10$) between domestic out-of-state and domestic-in-state students.

Gender

Least square means for ABA, AEA, AI, ITS, LDTS, TI, FTS, and FA for male and female students at WKU are presented in Table 9. Males rated their knowledge higher than females at the end of the semester ($P = .07$). However, gender had no significant effect ($P > .10$) on ABA, AI, ITS, LDTS, TI, FTS, and FA. Although the numerical difference for ABA appears similar to the differences in AEA, the standard errors of the ABA are much larger. There appeared to be much more variation among perceptions of both sexes at the beginning of the semester when compared to the end of the semester.

Lab Enrollment

Least squares means for ABA, AEA, AI, ITS, LDTS, TI, FTS, and FA for students enrolled and not enrolled in ANSC 141 lab are presented in Table 10. The subjective ABA and AEA estimates between those enrolled and those not enrolled in lab
were not significantly different ($P > .10$). However, students enrolled in lab showed a significantly greater improvement (45.61 vs. 35.08) of their assessment from the beginning to the end of the semester ($P = .07$).

Significant differences were found for ITS at the beginning of the semester ($P = .008$), but no significant differences ($P > .10$) were found for LDTS or TI. The difference in the 50-point examination between groups was 5.35 points on the ITS and reduced to 1.93 points between groups on the LDTS. When student performance of these two groups were compared, those enrolled in lab had significantly higher FT ($P = .01$) and FA ($P = .09$).

**Community Size**

Least squares means for ABA, AEA, AI, ITS, LDTS, TI, FTS, and FA for students that originated from different community sizes are presented in Table 11. There were no significant differences ($P > .10$) between groups on the ABA or TI. The AEA for students considering themselves from a rural acreage, communities with populations of 10,000 to 100,000 and communities with populations of 100,000 to 1,000,000 were higher ($P < .10$) at the end of the semester than those from rural farms or ranches. Similarly, those students who considered themselves to be from communities with populations ranging from 10,000 to 100,000 accessed their knowledge at the end of the semester significantly higher ($P < .10$) than those from communities of 1,000 to 10,000 and those from small communities with populations less than 1,000 people.

Significant LDTS ($P < .10$) differences were found among groups. Those students grouping themselves in all other community sizes except large cities performed significantly higher than those from smaller communities (population < 1000). Though
not significant \((P > .10)\), those students from small communities (population < 1000) had lower ITS and FT than all other groups. These students also rated their knowledge the lowest compared to all other groups on the last assessment, but apparently misinterpreted their knowledge at the beginning with the highest average assessment as a group compared to all others. There were no significant differences \((P > .10)\) among groups for FTS and FA, but those from small communities tended to have the lowest FTS and FA of all groups. There were only 11 students in this category, therefore, these results may or may not be valid.

**Pre-college 4-H and FFA activity**

Kentucky and many other states have extensive 4-H and FFA programs that emphasize projects and learning experiences in agriculture. It was decided to determine whether activity level in one or both of these national organizations had an effect on their assessment and performance within the class. There were no significant differences \((P > .10)\) among means on ABA, AEA, and AI (Table 12). There were significant differences on the ITS \((P = .09)\) and TI \((P = .02)\). On the ITS, students that accessed their activity in FFA as being very active scored significantly higher \((P < .10)\) than those indicating no involvement in either organization, those who were very active in 4-H, those with limited activity in FFA, and those involved in both organizations but not active. On TI, the group that rated their involvement in FFA as very active improved the least compared to all other groups and was significantly \((P < .02)\) lower than those who were not involved in either organization, those considering themselves very active in only 4-H, those with limited activity in FFA, and those with varying activity levels in both organizations.
There were no significant differences ($P > .10$) though when groups were compared on how they performed on their FTS and their FA.

**Relationships among instruments**

Coefficients of correlation between subjective and objective measures in the study are presented in Table 13. ABA and AEA have little association with one another. ABA had a strong negative correlation with AI ($r = -.85$). When comparing objective measures (ITS, LDTS, TI, FTS, FA, and Laboratory grade) the ITS had little association with the LDTS ($r = .32$). The ITS had a moderately negative association with the TI ($r = -.44$). The LDTS had a strong positive correlation with TI ($r = .71$). The LDTS also described the most variation in the FTS and FA with $r^2$ values of .55 and .46, respectively. The FTS showed the highest correlation ($r = .91$) with FA. Students’ lab grades had highly positive correlations with FTS ($r = .69$) and FA ($r = .74$) in the class.

ABA estimates had the highest correlation with ITS ($r = .22$). All other objective measures had even lower correlations with ABA. AEA had a slightly higher association with the objective measures, but at most, only described 12 percent of the variation associated with FTS and FA.

**Predicting college outcomes with pre-college indicators.**

The coefficients of correlation between various predictions of college performance, objective scores, subjective scores, and lab grades are presented in Table 14. These data represent only those students who had ACT scores. Correlations between perceptions of knowledge at the beginning and end of the semester with pre-college performance scores ranged from -.01 to .14. The objective measures were more highly predictable using pre-college performance measures. Correlations between pre-college
performance measures and the objectively based 50-point test scores (ITS and LDTS) ranged from .21 to .42. However, pre-college measures were more useful in predicting scores on the FT, FA, and laboratory grade (r-values ranging from .42 to .60). MATH had the highest association with FT (r = .52) while HSPILE had the most potential for predicting FA (r = .60).

Independent variables that were pre-college performance measures and those collected at the beginning of the class were used in a multiple regression analysis to assess their potential to predict FA. The independent variables used in this model were the ITS, ABA, ENG, MATH, READ, SCI, COMP, HSPILE, and HSGPA. A stepwise regression method revealed that HSPILE was the most useful in predicting FA with a partial $R^2$ of .39. Other variables left in as significant ($P < .10$) contributors of variance were ITS (partial $R^2 = .06$) and COMP (partial $R^2 = .03$). Even though the regression analysis showed statistical significance for 3 independent variables as predictors of ANSC 140 performance, the $R^2$ value of .49 is not large enough to warrant use of the equation for predicting success in ANSC 140.

**Coefficients of correlation among instruments within gender**

Coefficients of correlation between subjective and objective measures of animal science knowledge and pre-college scores for male and female students are presented in Tables 15 and 16. In both cases there were fewer coefficients of correlation that were significant, possibly explained by a lower number of observations. Subjective assessment scores had little relationship to the pre-college performance measures for both female ($r < .25$) and male ($r < .23$) students. Female COMP was most highly associated with performance on FTS, FA, and laboratory grade ($r = .63, .64,$ and .60). All the
correlations between ACT scores and FTS, FA, and laboratory grade appeared to be higher for females than males. In contrast, the correlation between HSPILE and laboratory grade was higher for males than females. In both cases there must be other factors that are not accounted for in predicting student performance.
Chapter 5
DISCUSSION

Analysis of standard errors of ABA and AEA in each particular least squares mean table indicates that students perception of knowledge was more centered at the end of the semester than at the beginning. This is most likely due to more accurate perceptions of knowledge based on a clearer understanding of their knowledge as it relates to course subject matter at the end of the semester. At the beginning of the class students may have recognized some of the terms and phrases used in the outcomes statements, but they did not know how the information would be covered or how it is appropriately utilized in the animal industry. Hence, their initial knowledge estimations were more scattered. Additionally, the ABA estimations were not as closely related to scores on the objective instruments taken at the end of the class (LDTS and FTS) and the FA and lab grade as the AEA, further indicating that student perception estimates are more accurate at the end of the semester.

The differences in AEA for current accumulated WKU hours could be attributed to the fact that students with zero to 64 hours may have been those who attended class more punctually and were more confident in their estimation than students with over 64 hours who did not understand topics with as much confidence. At the beginning of the semester those students with over 64 credit hours appeared to have the lowest ABA but the highest ITS. Whereas at the end of the semester those students had the lowest AEA, LDTS, and FTS, indicating the subjective instrument was a better indicator of knowledge at the end of the semester than at the beginning. Students with freshman status also had the highest FTS. This may indicate that first year students either have more academic
ability or were more academically committed in class. Also, a large number of the freshmen enrolled in Animal Science 140 were pre-veterinary students who are likely to be more academically committed to higher scholastic standards because of their career goals. Those students with more than 64 hours may have had a lower motivation resulting from a higher percentage of them pursuing studies unrelated to animal science. This may result in lower interest in the subject matter, and hence, lower scores in the class.

A portion of the student body in the Department of Agriculture at WKU consists of students from out of state (IN, TN, IL, etc.). These students had different educational backgrounds prior to entering WKU, however, there were no significant differences in performance between in-state and out-of-state students. ABA was higher than ITS for in-state students while the opposite was true for the out-of-state students. Both groups over estimated their knowledge at the end of the semester based on their performance on the objective examinations.

The current study indicates that subjective and objective measures of class performance are not different between gender for the introduction to animal science sections considered in this study. This provides confidence that methods used in teaching the class do not bias gender specific performance. In contrast, other studies have reported that females obtained higher grade point averages when compared to males (Bridgeman and Wendler, 1991; Young, 1991). However, Hewitt and Goldman (1975) reported little difference between sexes when major was considered. These data are in agreement with the current results of this study.
Result indicate that students enrolled in both the lecture and lab had higher performance on the ITS, FTS, and FA. Pre-veterinary and Animal Science students are required to enroll in the lab, but the lab is not required for students majoring in other areas. These students, being more academically inclined, could be more apt to perform at a higher level at the beginning of the semester and thus bias the results upward. Higher performance on the FT and FA by those enrolled in lab also is indicative of a stronger association between topics covered in the lab and the topics covered on the FT that were not part of the LDTS than those topics that were part of the LDTS.

Low LDTS and TI for students from small communities (< 1,000) could be an artifact of a low number of observations (n = 11). However, it is possible that these students may not have had similar academic opportunities to those from larger cities and rural areas. As a result they may not have been prepared for college level academics. This same group also had one of the lowest AEA but the highest ABA, clearly indicating that the subjective instrument was not accurate in assessing knowledge at the beggning of the semester.

Students considering themselves as very active in FFA had a greater understanding of the topics that were to be presented in the class as apparent by their ITS. These students evidently had good animal backgrounds and experiences before entering WKU. As indicated by the LDTS, these students did not make as much recorded progress as the other groups. These results suggest that the very active FFA students came into the class with better animal backgrounds, but these students apparently were not as effective in gaining an understanding of the material presented in class. This is possibly a result of their unwillingness to put forth the effort necessary to master new
concepts of animal science, poorer study habits or less interest in material discussed in class. It also shows the need for instructors to find different teaching methods to better assist those students in class.

The strong negative association between ABA and AI clearly suggests that students' assessment scores improved from the beginning to the end of class and is indicative that students at least perceived they gained knowledge by enrolling in ANSC 140. The relationship of the AEA to the FTS, FA, and lab grade as compared to the relationship of the ABA to the FTS, FA, and lab grade clearly illustrates that students are more accurate in their estimation at the end of the semester. This is most likely a result of better student understanding of each topic and greater understanding of their knowledge in each subject.

Similarly, the moderately negative relationship between ITS and TI is an indication that some students who performed relatively poorly on the first test improved or possibly made more effort in adding to their knowledge base than those who had higher performance on the ITS. The FTS had a higher relationship with the FA than did LDTS indicating that the questions on the FT that were not included in the LDTS more effectively covered those subjects that had been covered in class as well as previous examinations and quizzes.

When comparing subjective and objective measures, it is apparent that student perception of knowledge is due to factors not related to the various objective measures. Overall, the coefficients of correlation between objective and subjective measures show that teacher accountability cannot be solely evaluated by student perceptions. The subjective measurement still has meaning albeit from a student satisfaction standpoint.
Student satisfaction of academic experiences may be the most important outcome measurement, and this study indicates a higher level of student satisfaction than of knowledge gained from the introduction to animal science classes. A more intensive approach may be needed to assess the actual teacher effectiveness. Using a combination of the two assessments could be more effective in understanding if students are content with their progress and to chart actual progress and hence, teacher effectiveness. The assessment methodology employed in the present study was more extensive than the subjective evaluations of learning incorporated by the ISU Animal Science Department to evaluate teacher accountability (Skarr and Kenealy, 1997).

Coefficients of Correlation between subjective measurements and pre-college performance measures clearly illustrate that students’ perceptions of knowledge about animal science is not highly related to the ACT, HSPILE, or HSGPA. Additionally, using pre-college performance measures independently to predict performance on the 50-point test would not account for enough variation to be warranted. Furthermore, using these as sole indicators of collegiate academic potential is not warranted due to low $r^2$ values.

Female pre-college performance measures appear to be more reliable in the prediction of objective measures of class performance in the present study. However, it is clear that the subjective assessment has little relationship to objective measures for both genders, indicating students’ perceptions have little to do with their actual knowledge. The most intriguing difference in relationships were those pre-college performance measures that best described the variation within specific gender. Variation in male FTS, FA, and lab grade was best described by HSPILE while the FTS, FA, and
lab grade for the females was best described by COMP. In either case, the low \( r^2 \) would not warrant use of these parameters to predict the FTS, FA or lab grade. Other studies have shown that while males generally performed higher on standardized examinations, females often obtained higher first year grade point averages than males and had ACT scores that were more highly related to their performance (Bridgeman and Wendler, 1991; Young, 1991). Explanations for these differences in grade point averages have been attributed to the fact that females often pursued less difficult majors. In the current study, ACT scores for females still had higher associations with all objective performance measures than ACT scores for males even though the measures were obtained from students enrolled in the same class.

Results from this study indicate that certain groups of students, as identified by demographic information, need to take the class earlier in their college career or may need more assistance from the instructors in the form of recitation or some other classroom material reinforcement methods. It is important to note, that students causing significant differences in one group could also be associated with variation in other groups, possibly confounding results. However, by being able to identify students with potential academic difficulties in the course, instructors could use alternative or additional teaching methods to provide student assistance in order that their classroom performance could be improved. Learning styles could be studied in the hope of finding more effective teaching styles to better fit the needs of all students. Additionally, it may be beneficial to require students not presently enrolled in laboratory to participate in some type of accompanying class in order to provide topical reinforcement to materials covered in the traditional class lecture.
Pre-college performance measures do appear to have potential in predicting student success. However, the results from this study indicate that the use of pre-college performance measures as sole predictors of student success is not warranted. It is apparent that other factors are involved and students should understand that performance on standardized tests does not guarantee or preclude academic success in college.
Chapter 6

SUMMARY

A project was designed to evaluate student outcomes and potential predictors of performance in Animal Science (ANSC) 140 at WKU. The students in this study consisted of those enrolled in ANSC 140 starting in the fall of 1999 and ending with the section enrolled in the spring semester of 2001. Those students enrolled voluntarily participated in the study and completed both a subjectively based and an objectively based instrument at the beginning and end of the class. The effect of student demographic data on student outcomes and performance in class was also studied. Secondly, coefficients of correlation were calculated to determine any associations that could have value in predicting outcomes on class performance.

Demographic components had no significant effects on the ABA. However, gender, environment and current accumulated WKU hours classification had significant effects on AEA. Additionally, lab enrollment status had a significant effect on AI in assessment from the beginning of the semester to the end.

Lab enrollment status and degree of activity level in 4-H and FFA in high school had significant effects on the ITS. Community size also had a significant effect on the LDTS. Additionally, the number of hours accumulated at Western before taking the class and the degree of activity level in 4-H and FFA had significant effects on TI. Lab enrollment affected students’ scores on both the FT and FA. Additionally, the FT was affected by current accumulated WKU hours taken before entering Animal Science 140.

AEA for students with more than 64 hours were significantly lower than those with 64 hours or less. Those students with 0-32 hours significantly showed more TI and
had significantly higher scores on the FTS than all other students. Students categorized by gender showed that males significantly estimated their knowledge higher at the end of the semester. Students categorized by laboratory enrollment showed that those enrolled in laboratory had a significantly greater AI, higher ITS, higher FT, and higher FA. Students categorized by the community size in which they lived shows that students from a rural farm or ranch had significantly lower AEA values than students from a rural acreage, large communities, and large cities. AEA for students from large cities were significantly higher than those from a rural acreage, small communities, and medium sized communities. Students from small communities also had significantly lower LDTS than those from a rural farm or ranch, rural acreage, medium sized community, and large communities.

The level of activity or involvement in 4-H, FFA, or both, shows that students who were very active in FFA had significantly higher ITS than those not involved in either organization, very active in 4-H, not very active in FFA, and members of both that were not very active in either. Conversely, students in this same group had the lowest TI (P = .02) when compared to students who considered themselves not involved in either organization, very active in 4-H, and members of FFA but not very active.

AI had the strongest correlation with ABA (r = -.86). The highest coefficient of correlation between ABA and the objective performance measures was .22 with the ITS. AEA had a moderate relationship to the FT, FA, and the lab grade (.34, .34, and .31, respectively).

The objectively based 50-point tests scores were more closely related to FT, FA, and lab grade than the subjective measures. The ITS had a moderately positive
relationship to FT, FA, and lab grade (.40, .38, and .42, respectively). The LDTS had moderately strong positive relationships with FT, FA, and lab grade (.74, .68, and .49, respectively). Finally, TI had moderate association with FT (r = .40) and FA (r = .36) while having little association with the lab grade (r = .13).

Coefficients of correlation were calculated between high school performance measures (Components of the ACT, HSGPA, and HSPILE) and outcome variables. The outcome assessments had very little significant correlation to any of the high school performance measures (r < .14). The pre-college measures had slightly higher relationships with scores on the 50-point test (.02 < r < .42). The highest correlation was between the HSPILE and the LDTS (r = .42) and the lowest between TI and MATH (r = .15).

Coefficients of correlation between high school performance measures and FT, FA, and lab grade relationships tended to be moderate (.42 < r < .60). MATH had the highest association for FTS (r = .52) while READ had the lowest (r = .42). HSPILE had the highest correlation with final average (r = .60) while READ had the lowest (r = .48). HSPILE had the highest coefficient of correlation with laboratory grade (r = .58) while the ENG had the lowest (r = .43).

The highest significant relationships for the subjective assessments, when genders were separated, were between AEA and the COMP for females (r = .26) and the AEA and MATH (r = -.28) for males. The male high school performance measures had no significant relationship to the objectively based scores while female COMP showed the highest relationship with ITS and LDTS (r = .38 and .30, respectively). COMP had the highest predicting potential for female FT, FA, and laboratory grades (r = .49, .52, and .51, respectively). READ was the most highly correlated with FT (r = .26) and HSPILE
was the most highly correlated to both FA and laboratory grade ($r = .39$ and $.50$, respectively).

There are additional factors that need to be studied. The current data set can be studied further using other demographic data compiled to further assess student retention, success after college, university grade point average, and the percentage of various types of students in the class.

Class dropout is a problem nationwide. The use of the data from those students who did not complete ANSC 140 could be studied in an attempt to determine if there could be a common basis for failure to complete the class. Additionally, results from this study indicate that only using opinion-based evaluations is not an accurate means to determine how much class material that students comprehend. Rather, a combination of both a perception based instrument and an objectively based test may be a better means to measure both student perception of quality class environment and teacher effectiveness. By analyzing scores on specific outcome statements and combining the questions that correspond to these on initial performance tests, there may be the possibility of altering teaching methods to more effectively cover specific topics.

The demographics of a class could also be a tool to use for implementing varied methods of teaching. Extra study sessions or other instructional materials may need to be incorporated from semester to semester according to demographic makeup of the specific class.

More investigation is needed to conclude any further results. Separation of outcome statements and questions on the 50-point test on a subject by subject basis could be a means to determine which subject matters are or are not covered effectively.
Additionally, teaching instruments used in lecture by the instructors could be studied for effectiveness.
Table 1. Instrument for assessing student outcomes in animal science

Please rate your knowledge level on each statement below by scoring yourself on a scale of 1-100 on the accompanying page.

After completing this class, students will be able to:

1. Write and converse about animal science and the animal industries of the US using appropriate terminology.
2. Give the scientific classification of all species of farm animals, dogs, and cats.
3. Give the correct names for animals of different sexes and age groups for each farm animal species.
4. Describe the animal demographics of the US and the world.
6. Describe the structure (segments) of the food animal industries of the US.
7. Describe the digestive systems of each farm animal species.
8. Describe rumination and the major differences between ruminant and non-ruminant digestion and metabolism.
9. Name the basic classes of nutrients, describe the basic chemical composition of each and explain the role of each in animal nutrition.
10. Explain the general concept of metabolism (catabolism and anabolism).
11. Describe commonly occurring metabolic disorders and infectious diseases of farm animals.
12. Describe and characterize the forage crops most commonly used for pasture, hay, and silage.
13. Describe and classify the common feedstuffs used for supplying nutrients to livestock.
14. Describe the normal reproductive phenomena of each farm animal species.
15. Contrast the fundamental differences in the life cycles among domestic animal species.
16. Identify male and female farm animal reproductive organs and describe the functions of each.

17. Explain the endocrine control of reproduction, lactation, and other basic physiologic functions in farm animals.

18. Describe lactation curves and milk composition for each farm animal species.

19. Describe the differences between colostrum and normal milk.

20. Describe the basic concepts of immune system function.

21. Explain mammary gland structure and function using the dairy cow as a model.

22. Describe the domestication of animals.

23. Describe the processes of evolution, artificial selection and the development of types, breeds, and synthetic lines of farm animals.

24. Recognize and describe the major breeds of beef cattle, dairy cattle, horses, sheep, and swine.

25. Describe livestock breed associations and give their primary and secondary functions.

26. Explain the basic concepts of qualitative and quantitative inheritance in farm animals.

27. Calculate the fractional breed composition of progeny resulting from mating parents of different breed composition.

28. Explain the mating systems that may be utilized by livestock producers and the expected results of each.

29. Explain inbreeding depression and hybrid vigor and the effects of each upon animal performance.

30. Describe commonly used records system utilized in the dairy and livestock industries.

31. Explain the use of EPDs and PTAs in farm animal improvement programs.

32. Explain the role of molecular genetic concepts in livestock selection programs.

33. Describe the use of recombinant DNA technology in animal science and list the major biotechnological accomplishments that have become commonly used in the animal industries.

34. Name the parts of the beef animal, dairy cow, horse, pig, and sheep.
35. Name the wholesale cuts and the major retail cuts of beef, pork, and lamb carcasses.

36. Describe the reasons for cooking meat, the major methods of meat cookery and the ideal methods of cooking common retail cuts.

37. Recognize the major muscles present in retail cuts taken from near the backbone.

38. Describe differences in tenderness among retail cuts of meat and discuss the reasons why these differences occur.

39. Name and describe the classes of market animals for each livestock species.

40. Describe USDA inspection and grading of carcasses and list the criteria for determining the grades of beef, pork, and lamb carcasses.

41. Describe growth curves in livestock and relate differential patterns of growth to weight as slaughter, carcass composition, and carcass quality.

42. Describe changes in dressing percent and carcass composition as animals grow and develop from birth to maturity.

43. Describe growth and composition differences among the sexes of cattle, swine, and sheep.

44. Give industry average feed conversion ratios for each species of meat animals and describe reasons for differences within and among species.

45. Calculate feed conversion ratios using growth and feed consumption data.

46. Discuss the major food safety issues relating to foods of animal origin.

47. Describe the nutritional attributes of the common foods of animal origin and relate the perceived health problems that result from consumption of these foods.

48. Provide production goals and compare those goals to industry averages for each farm animal species.

49. Describe the organizations that support, promote, and oppose animal agriculture.
Table 2. Demographic questionnaire administered at the beginning of each semester.

Background responses (use spaces 50-61 on the response sheet). Circle the most appropriate response(s).

50. My gender is ...
   a. Male.         b. Female.

51. I am considered ...
   a. An international student.
   b. A domestic out-of-state student.
   c. A domestic in-state student

52. I consider myself to be a...
   a. Food animal oriented student.
   b. Non-food animal oriented student.

53. How many transfer hours do you have at this point?
   a. 0-12
   b. 13-32 from a 2 year program or AP
   c. 13-32 from a 4 year program
   d. over 32 from 2 year program or AP
   e. Over 32 from a 4 year program

54. How many hours credit do you have at WKU?
   a. 0
   b. 16-32
   c. 32-64
   d. >64

55. My primary animal experience is with (pick one only) ...
   a. Companion animals (dogs, cats).
   b. Exotic animals (including birds, reptiles).
   c. Dairy animals.
   d. Horses.
   e. Beef.
   f. Sheep.
   g. Swine.
   h. Other species not fitting above categories.
56. The predominant environment I am from is best described as....
   a. Rural farm or ranch.        d. Medium community (1,000-10,000 people).
   b. Rural acreage (part-time farm or ranch).  
   c. Small community (<1,000 people).

57. My primary career plans or future interests after I receive my BS degree are....
   a. Production agriculture (farm, management, home farm, etc.) (teaching, extension, government, etc.)
   b. Veterinary medicine, large animal interests.
   c. Veterinary medicine, small animal interests. Sales and marketing of agri-products.
   d. Meats or foods industry.
   e. Public service.
   f. Business management
   g. Graduate school.
   h. Other or I don't know yet.

58. I consider the following to best describe my activities in 4-H and FFA...
   a. Not a member of either organization.
   b. Member of 4-H -not active.
   c. Member of 4-H -very active.
   d. Member of FFA -not active.
   e. Member of FFA -very active.
   f. Member of both 4-H & FFA -not active.
   g. Member of both 4-H & FFA -very active.

59. My major area of interest is....
   b. Dairy science.                      i. Agronomy -soil science.
   d. Ag education.                      k. Pre-veterinary.
   e. Ag business.                      l. Non-agricultural.
   f. Turf management.
   g. Environmental science.
60. I expect my grade in this course will be an ...
   a. A. d. D
   b. B. e. E
   c. C

61. I expect this course to be....
   a. Really easy or not challenging. d. Difficult
   b. Easy. e. Very difficult or very challenging
   c. Moderately difficult.

62. What is your age?
   a. <20 d. 30-40
   b. 20-25 e. >40
   c. 25-30

63. Which animal products do you regularly consume?
   a. None e. Chicken
   b. Beef f. Eggs
   c. Pork g. Dairy products
   d. Lamb

64. Which statement best describes your position concerning tobacco?
   a. Tobacco production should be outlawed.
   b. Tobacco should be classified as an illegal drug such as marijuana.
   c. Production of tobacco is an honorable profession, but use of tobacco products should be outlawed in public and for anyone under the age of 18.
   d. Production of tobacco is an honorable profession, and the use of and promotion of tobacco products should be free from governmental regulation.
65. Which statement best describes your position concerning genetically altered foods?
   a. Genetically altered plant and animal products should not be legal for human consumption.
   b. Genetically altered plant and animal products should be available for human consumption, but be labeled as such.
   c. Genetically altered plant and animal products should be handled similar to other food products with no labeling to distinguish them from other foodstuffs.
   d. Genetically altered plant and animal products should not be produced because of potential for "upsetting nature's balance" of "normal" plants and animals.

66. Which statement best describes your position concerning animal rights/welfare?
   a. Animals have similar rights to humans.
   b. Animals have no rights.
   c. The government should establish strict rules about handling and managing animals.
   d. Animals should be treated humanly and managed in a manner to optimize the economics of production.

67. Which statement best describes your position on protecting the environment?
   a. All agriculture should become sustainable by using only "organic" farming practices.
   b. Herbicides, pesticides, and antibiotics should be legal if used according to label directions.
   c. Every farmer should be held liable for acts of environmental pollution.
   d. Because of the need for food, agricultural production should be maximized regardless of the environmental effects.
68. Which best describes your position on "factory" farming?

a. Food should be produced in the most efficient manner regardless of size of operation.

b. Size of farming operations should be restricted.

c. Family farms should be encouraged by the government by providing production subsidies to "smaller" operations.

d. Tax breaks should be used to encourage "family farms" to remain in business.

69. Which of the following will be the most important consideration of your prospective employer?

a. GPA

b. Communication skills

c. Work experience

d. Leadership potential expenses

e. Work ethic

f. Willingness to move

g. My own contribution to my education

70. What do you expect your annual starting salary to be after graduation from college?
Table 3. Outcomes instrument administered in the introductory animal science course at Iowa State University.

Course No: AnS 114

Title: Survey of the Animal Industry

**Student Outcomes:**
After completing this course, students will be able to do the following:

1. Define and use in context the terminology that characterizes domestic animals.
2. Identify common types and breeds of domestic animals.
3. Characterize the role that domesticated animals have played in the development of civilization.
4. Identify characteristics of food and non-food products that domesticated animals provide to meet human needs.
5. Discuss past, present and anticipated trends in the production and use of animals and animal derived products.
6. Describe the economic impact of domesticated animal usage in U.S. and international markets.
7. Describe the segments of the domestic animal related industries.
8. Describe the organizations that support, promote and oppose animal agriculture.
9. Contrast the fundamental differences in the life cycles among domestic animal species.
Table 4. Descriptive Statistics for the Animal Science 140 outcomes assessment at Western Kentucky University

<table>
<thead>
<tr>
<th>Item</th>
<th>Levels</th>
<th>Values</th>
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<td>Section</td>
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<td>(1 or 2)</td>
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<tr>
<td>Semester</td>
<td>2</td>
<td>(Fall, Spring)</td>
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<td>Year</td>
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<td>(1999, 2000, 2001)</td>
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<td>(0-32, 32-64, &gt;64)</td>
</tr>
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<td>Student Type</td>
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<td>(domestic in-state or domestic out-of-state)</td>
</tr>
<tr>
<td>Gender</td>
<td>2</td>
<td>(Male, Female)</td>
</tr>
<tr>
<td>Lab Enrollment</td>
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<td>(Enrolled, Not enrolled)</td>
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<td>Community Size</td>
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<td>(See table 10)</td>
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<tr>
<td>Pre-college 4-H and FFA activity</td>
<td>7</td>
<td>(See table 11)</td>
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Table 5. Sources of variation and associated probabilities of a greater F-value for students in Animal Science 140 at Western Kentucky University

<table>
<thead>
<tr>
<th>Source</th>
<th>Average Beginning Assessment</th>
<th>Average Ending Assessment</th>
<th>Average Improvement</th>
<th>Initial Day Test</th>
<th>Last Day Test</th>
<th>Test Improvement</th>
<th>Final Test</th>
<th>Final Average</th>
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<td>.95</td>
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<td>.83</td>
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<td>Community Size</td>
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<td>.26</td>
<td>.09</td>
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<td>.02</td>
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Table 6. Least squares means (± SE) by year, semester and section for Average beginning assessment, Average ending assessment, Average improvement, Initial test score, Last day test score, Test Improvement, Final test score, and Final average among students enrolled in animal science 140 at Western Kentucky University.

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Beginning Assessment</th>
<th>Average Ending Assessment</th>
<th>Average Improvement</th>
<th>Initial Test Score</th>
<th>Last Day Test Score</th>
<th>Test Improvement</th>
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<th>Final Average</th>
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<td>38.38&lt;sup&gt;a&lt;/sup&gt; 2.82</td>
<td>59.22 4.01</td>
<td>20.84&lt;sup&gt;a&lt;/sup&gt; 4.54</td>
<td>61.21 3.55</td>
<td>69.91 3.43</td>
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<tr>
<td>2000 (108)</td>
<td>33.27 7.58</td>
<td>72.99 4.56</td>
<td>39.73 7.75</td>
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<td>59.74 3.75</td>
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<td>60.79 3.32</td>
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<td>39.94 10.70</td>
<td>25.22&lt;sup&gt;b&lt;/sup&gt; 3.64</td>
<td>59.97 5.18</td>
<td>34.74&lt;sup&gt;b&lt;/sup&gt; 5.87</td>
<td>64.98 4.58</td>
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<td>Fall (151)</td>
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<td>45.14 6.82</td>
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<td>23.79 3.73</td>
<td>63.25 2.92</td>
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<td>72.47 6.03</td>
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<tr>
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<td>2 (83)</td>
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<td>25.53 4.84</td>
<td>61.75 3.78</td>
<td>70.34 3.66</td>
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</table>

<sup>a</sup> Means within a column with uncommon superscripts differ (P < 0.10).
Table 7. Least squares means (± SE) for Average beginning assessment, Average ending assessment, Average improvement, Initial day test score, Last day test score, Test improvement, Final test score, and Final average for students categorized by number of accumulated Western Kentucky University hours before enrolling in Animal Science 140 at Western Kentucky University

<table>
<thead>
<tr>
<th>Current WKU Hours</th>
<th>N</th>
<th>Average Beginning Assessment</th>
<th>Average Ending Assessment</th>
<th>Average Improvement</th>
<th>Initial Day Test</th>
<th>Last Day Test</th>
<th>Test Improvement</th>
<th>Final Test</th>
<th>Final Average</th>
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<td>LSM  SE</td>
<td>LSM  SE</td>
<td>LSM  SE</td>
<td>LSM  SE</td>
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<td>LSM  SE</td>
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<td>68.27a 4.42</td>
<td>73.24 4.28</td>
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<td>32 – 64</td>
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<td>79.41a 4.94</td>
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<td>29.85 2.86</td>
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<td>&gt; 64</td>
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<td>22.51b 5.37</td>
<td>58.37b 4.19</td>
<td>67.75 4.06</td>
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1 Means within a column with uncommon superscripts differ (P < 0.10).
Table 8. Least squares means (± SE) for Average beginning assessment, Average ending assessment, Average improvement, Initial day test score, Last day test score, Test improvement, Final test score, and Final average for students considered domestic out-of-state or domestic in-state enrolled in animal science 140 at Western Kentucky University

<table>
<thead>
<tr>
<th>Student Type</th>
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<th>Average Beginning Assessment</th>
<th>Average Ending Assessment</th>
<th>Average Improvement</th>
<th>Initial Day Test</th>
<th>Last Day Test</th>
<th>Test Improvement</th>
<th>Final Test</th>
<th>Final Average</th>
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</thead>
<tbody>
<tr>
<td>Domestic Out-of-state</td>
<td>43</td>
<td>38.73 ± 9.19</td>
<td>74.26 ± 5.53</td>
<td>35.52 ± 9.40</td>
<td>34.76 ± 3.20</td>
<td>60.19 ± 4.55</td>
<td>25.43 ± 5.16</td>
<td>63.24 ± 4.03</td>
<td>71.68 ± 3.90</td>
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<tr>
<td>Domestic in-state</td>
<td>179</td>
<td>27.99 ± 7.04</td>
<td>73.15 ± 4.23</td>
<td>45.15 ± 7.20</td>
<td>33.42 ± 2.45</td>
<td>59.10 ± 3.48</td>
<td>25.68 ± 3.95</td>
<td>61.41 ± 3.08</td>
<td>68.66 ± 2.98</td>
</tr>
</tbody>
</table>

Means within a column with uncommon superscripts differ ($P < 0.10$).
Table 9. Least squares means (± SE) for Average beginning assessment, Average ending assessment, Average improvement, Initial day test score, Last day test score, Test improvement, Final test score, and Final average for male and female students enrolled in Animal Science 140 at Western Kentucky University

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Average Beginning Assessment</th>
<th>Average Ending Assessment</th>
<th>Average Improvement</th>
<th>Initial Day Test</th>
<th>Last Day Test</th>
<th>Test Improvement</th>
<th>Final Test</th>
<th>Final Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LSM</td>
<td>SE</td>
<td>LSM</td>
<td>SE</td>
<td>LSM</td>
<td>SE</td>
<td>LSM</td>
<td>SE</td>
<td>LSM</td>
</tr>
<tr>
<td>Male</td>
<td>109</td>
<td>35.69</td>
<td>7.51</td>
<td>76.72</td>
<td>4.52</td>
<td>41.02</td>
<td>7.68</td>
<td>34.27</td>
<td>2.61</td>
</tr>
<tr>
<td>Female</td>
<td>116</td>
<td>31.03</td>
<td>8.33</td>
<td>70.70</td>
<td>5.01</td>
<td>39.66</td>
<td>8.52</td>
<td>33.88</td>
<td>2.90</td>
</tr>
</tbody>
</table>

*Means within a column with uncommon superscripts differ \( P < 0.10 \).
Table 10. Least squares means (± SE) for Average beginning assessment, Average ending assessment, Average improvement, Initial day test score, Last day test score, Test improvement, Final test score, and Final average for students both enrolled and not enrolled in Animal Science 141 lab at Western Kentucky University.

<table>
<thead>
<tr>
<th>Lab Enrollment</th>
<th>N</th>
<th>Average Beginning Assessment</th>
<th>Average Ending Assessment</th>
<th>Average Improvement</th>
<th>Initial Day Test</th>
<th>Last Day Test</th>
<th>Test Improvement</th>
<th>Final Test</th>
<th>Final Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LSM</td>
<td>LSM</td>
<td>LSM</td>
<td>LSM</td>
<td>LSM</td>
<td>LSM</td>
<td>LSM</td>
<td>LSM</td>
</tr>
<tr>
<td>Enrolled</td>
<td>128</td>
<td>30.47</td>
<td>8.52</td>
<td>76.08</td>
<td>5.13</td>
<td>45.61a</td>
<td>8.71</td>
<td>36.76a</td>
<td>2.97</td>
</tr>
<tr>
<td></td>
<td></td>
<td>36.61</td>
<td>4.22</td>
<td>60.61</td>
<td>2.97</td>
<td>64.45a</td>
<td></td>
<td>73.26a</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.11</td>
<td></td>
</tr>
<tr>
<td>Not Enrolled</td>
<td>96</td>
<td>36.25</td>
<td>7.34</td>
<td>71.33</td>
<td>4.41</td>
<td>35.08b</td>
<td>7.51</td>
<td>31.41b</td>
<td>2.56</td>
</tr>
<tr>
<td></td>
<td></td>
<td>58.68</td>
<td>3.63</td>
<td>27.26</td>
<td>4.11</td>
<td>60.21b</td>
<td></td>
<td>67.09b</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.11</td>
<td></td>
</tr>
</tbody>
</table>

*Means within a column with uncommon superscripts differ \( P < 0.10 \).
Table 11. Least squares means (± SE) for Average beginning assessment, Average ending assessment, Average improvement, Initial day test score, Last day test score, Test improvement, Final test score, and Final average for students who originated from different community sizes and enrolled in Animal Science 140 at Western Kentucky University

<table>
<thead>
<tr>
<th>Community Size</th>
<th>Average Beginning Assessment</th>
<th>Average Ending Assessment</th>
<th>Average Improvement</th>
<th>Initial Day Test</th>
<th>Last Day Test</th>
<th>Test Improvement</th>
<th>Final Test</th>
<th>Final Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>LSM</td>
<td>SE</td>
<td>LSM</td>
<td>SE</td>
<td>LSM</td>
<td>SE</td>
<td>LSM</td>
</tr>
<tr>
<td>Rural Farm/Ranch</td>
<td>80</td>
<td>26.13</td>
<td>7.93</td>
<td>67.84&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.77</td>
<td>41.72</td>
<td>8.12</td>
<td>33.93</td>
</tr>
<tr>
<td>Rural Acreage</td>
<td>42</td>
<td>38.86</td>
<td>8.62</td>
<td>75.59&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.18</td>
<td>36.73</td>
<td>8.81</td>
<td>34.00</td>
</tr>
<tr>
<td>Small Community (&lt; 1,000)</td>
<td>11</td>
<td>41.54</td>
<td>10.50</td>
<td>68.90&lt;sup&gt;c&lt;/sup&gt;</td>
<td>6.37</td>
<td>27.36</td>
<td>10.84</td>
<td>29.11</td>
</tr>
<tr>
<td>Medium Community (1,000 – 10,000)</td>
<td>45</td>
<td>25.60</td>
<td>9.55</td>
<td>70.25&lt;sup&gt;c&lt;/sup&gt;</td>
<td>5.74</td>
<td>44.65</td>
<td>9.76</td>
<td>32.50</td>
</tr>
<tr>
<td>Large Community (10,000 – 100,000)</td>
<td>32</td>
<td>37.40</td>
<td>9.01</td>
<td>79.21&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.42</td>
<td>41.81</td>
<td>9.22</td>
<td>35.57</td>
</tr>
<tr>
<td>Large City (100,000 – 1M)</td>
<td>12</td>
<td>30.65</td>
<td>13.18</td>
<td>80.44&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7.93</td>
<td>49.79</td>
<td>13.48</td>
<td>39.42</td>
</tr>
</tbody>
</table>

<sup>a</sup> Means within a column with uncommon superscripts differ (P < 0.10).
<table>
<thead>
<tr>
<th>Pre-College 4-H and FFA Activity</th>
<th>N</th>
<th>Average Beginning Assessment</th>
<th>Average Ending Assessment</th>
<th>Average Improvement</th>
<th>Initial Day Test</th>
<th>Last Day Test</th>
<th>Test Improvement</th>
<th>Final Test</th>
<th>Final Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not involved in either organization</td>
<td>82</td>
<td>37.23 7.83</td>
<td>69.98 4.71</td>
<td>32.74 8.00</td>
<td>32.36b 2.73</td>
<td>62.26 3.88</td>
<td>29.91ab 4.39</td>
<td>64.67 3.42</td>
<td>72.28 3.31</td>
</tr>
<tr>
<td>Member of 4-H (not active)</td>
<td></td>
<td>48.15 12.38</td>
<td>73.29 7.45</td>
<td>25.13 12.66</td>
<td>37.99ab 4.31</td>
<td>63.88 6.13</td>
<td>25.88abc 6.94</td>
<td>71.02 5.42</td>
<td>74.78 5.24</td>
</tr>
<tr>
<td>Member of 4-H (very active)</td>
<td>14</td>
<td>23.50 13.01</td>
<td>79.77 7.82</td>
<td>56.26 13.30</td>
<td>29.90b 4.53</td>
<td>62.65 6.44</td>
<td>32.75ab 7.30</td>
<td>58.94 5.69</td>
<td>68.12 5.51</td>
</tr>
<tr>
<td>Member of FFA (not active)</td>
<td>19</td>
<td>22.58 9.76</td>
<td>66.76 5.87</td>
<td>44.18 9.98</td>
<td>31.36b 3.40</td>
<td>64.28 4.83</td>
<td>32.92a 5.47</td>
<td>65.77 4.27</td>
<td>74.49 4.13</td>
</tr>
<tr>
<td>Member of FFA (very active)</td>
<td>53</td>
<td>32.00 9.12</td>
<td>71.21 5.48</td>
<td>39.20 9.32</td>
<td>38.18a 3.18</td>
<td>55.33 4.51</td>
<td>17.16c 5.11</td>
<td>59.17 3.99</td>
<td>67.91 3.86</td>
</tr>
<tr>
<td>Member of both 4-H &amp; FFA (not active)</td>
<td>9</td>
<td>26.35 14.86</td>
<td>75.41 8.93</td>
<td>49.05 15.19</td>
<td>30.31b 5.17</td>
<td>54.31 7.35</td>
<td>24.00abc 8.33</td>
<td>65.20 6.50</td>
<td>72.13 6.29</td>
</tr>
<tr>
<td>Member of both 4-H &amp; FFA (very active)</td>
<td>34</td>
<td>44.83 8.90</td>
<td>74.23 5.35</td>
<td>29.40 9.10</td>
<td>36.28ab 3.10</td>
<td>59.70 4.41</td>
<td>23.41abc 4.99</td>
<td>59.21 3.89</td>
<td>68.37 3.77</td>
</tr>
</tbody>
</table>

*Means within a column with uncommon superscripts differ (P < 0.10).
Table 13. Coefficients of correlation between subjective (Average beginning assessment, Average ending assessment, Average improvement) and objective measures (Initial test score, Last day test score, Test improvement, Final test score, Final average, and Laboratory Grade) of knowledge and performance for students in Animal Science 140 at Western Kentucky University *(n = 212 *)

<table>
<thead>
<tr>
<th></th>
<th>ABA</th>
<th>AEA</th>
<th>AI</th>
<th>ITS</th>
<th>LDTS</th>
<th>TI</th>
<th>FTS</th>
<th>FA</th>
<th>Lab Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABA</td>
<td>1</td>
<td>.26</td>
<td>-.84</td>
<td>.22</td>
<td>.004</td>
<td>-.16</td>
<td>.06</td>
<td>.04</td>
<td>.05</td>
</tr>
<tr>
<td>AEA</td>
<td>.26</td>
<td>1</td>
<td>.30</td>
<td>.18</td>
<td>.04</td>
<td>.34</td>
<td>.34</td>
<td>.31</td>
<td></td>
</tr>
<tr>
<td>AI</td>
<td>-.84</td>
<td>.30</td>
<td>1</td>
<td>-.11</td>
<td>.10</td>
<td>.19</td>
<td>.13</td>
<td>.15</td>
<td>.11</td>
</tr>
<tr>
<td>ITS</td>
<td>.22</td>
<td>.18</td>
<td>-.11</td>
<td>1</td>
<td>.32</td>
<td>-.44</td>
<td>.40</td>
<td>.38</td>
<td>.42</td>
</tr>
<tr>
<td>LDTS</td>
<td>.004</td>
<td>.18</td>
<td>.10</td>
<td>.32</td>
<td>1</td>
<td>.71</td>
<td>.74</td>
<td>.68</td>
<td>.49</td>
</tr>
<tr>
<td>TI</td>
<td>-.16</td>
<td>.04</td>
<td>.19</td>
<td>-.44</td>
<td>.71</td>
<td>1</td>
<td>.40</td>
<td>.36</td>
<td>.13</td>
</tr>
<tr>
<td>FTS</td>
<td>.06</td>
<td>.34</td>
<td>.13</td>
<td>.40</td>
<td>.74</td>
<td>.40</td>
<td>1</td>
<td>.91</td>
<td>.69</td>
</tr>
<tr>
<td>FA</td>
<td>.04</td>
<td>.34</td>
<td>.15</td>
<td>.38</td>
<td>.68</td>
<td>.36</td>
<td>.91</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Lab Grade</td>
<td>.05</td>
<td>.31</td>
<td>.11</td>
<td>.42</td>
<td>.49</td>
<td>.13</td>
<td>.69</td>
<td>.74</td>
<td>1</td>
</tr>
</tbody>
</table>

1 a = p < .01, b = p < .05, c = p < .10
2 n for laboratory grade = 121
3 Average beginning assessment = ABA
4 Average ending assessment = AEA
5 Average improvement = AI

6 Initial test score = ITS
7 Last day test score = LDTS
8 Test improvement = TI
9 Final test score = FTS
10 Final average = FA
Table 14. Coefficients of correlation between subjective and objective measures of animal science knowledge and pre-college performance scores for students enrolled in Animal Science 140 at Western Kentucky University

<table>
<thead>
<tr>
<th></th>
<th>English 10</th>
<th>Math 11</th>
<th>Read 12</th>
<th>Sci. 13</th>
<th>Comp 14</th>
<th>HSPILE 15</th>
<th>HSGPA 16</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>n</strong></td>
<td>n = 179</td>
<td>n = 179</td>
<td>n = 179</td>
<td>n = 179</td>
<td>n = 179</td>
<td>n = 144</td>
<td>n = 168</td>
</tr>
<tr>
<td>ABA 2</td>
<td>.08</td>
<td>-.01</td>
<td>.14 c</td>
<td>.12</td>
<td>.11</td>
<td>.10</td>
<td>.006</td>
</tr>
<tr>
<td>AEA 3</td>
<td>.12</td>
<td>.10</td>
<td>.13 c</td>
<td>.11</td>
<td>.14 c</td>
<td>.11</td>
<td>.10</td>
</tr>
<tr>
<td>AI 4</td>
<td>-.01</td>
<td>.07</td>
<td>-.07</td>
<td>-.06</td>
<td>-.03</td>
<td>-.03</td>
<td>.05</td>
</tr>
<tr>
<td>ITS 5</td>
<td>.25 a</td>
<td>.29 a</td>
<td>.34 a</td>
<td>.31 a</td>
<td>.34 a</td>
<td>.28 a</td>
<td>.21 a</td>
</tr>
<tr>
<td>LDTS 6</td>
<td>.29 a</td>
<td>.39 a</td>
<td>.29 a</td>
<td>.36 a</td>
<td>.36 a</td>
<td>.42 a</td>
<td>.37 a</td>
</tr>
<tr>
<td>TI 7</td>
<td>.09</td>
<td>.15 b</td>
<td>.02</td>
<td>.10</td>
<td>.09</td>
<td>.20 b</td>
<td>.20 a</td>
</tr>
<tr>
<td>FTS 8</td>
<td>.43 a</td>
<td>.52 a</td>
<td>.42 a</td>
<td>.49 a</td>
<td>.51 a</td>
<td>.51 a</td>
<td>.48 a</td>
</tr>
<tr>
<td>FA 9</td>
<td>.49 a</td>
<td>.55 a</td>
<td>.48 a</td>
<td>.54 a</td>
<td>.56 a</td>
<td>.60 a</td>
<td>.58 a</td>
</tr>
<tr>
<td>Lab Grade</td>
<td>.43 a</td>
<td>.52 a</td>
<td>.46 a</td>
<td>.53 a</td>
<td>.55 a</td>
<td>.58 a</td>
<td>.55 a</td>
</tr>
</tbody>
</table>

1 a = p < .01, b = p < .05, c = p < .10
2 Average beginning assessment = ABA
3 Average ending assessment = AEA
4 Average improvement = AI
5 Initial test score = ITS
6 Last day test score = LDTS
7 Test improvement = TI
8 Final test score = FTS
9 Final average = FA
10 ACT english = English
11 ACT math = Math
12 ACT reading = Read
13 ACT science = Sci.
14 ACT composite = Comp
15 High school percentile rank within class = HSPILE
16 High school grade point average = HSGPA
Table 15. Coefficients of correlation between male subjective and objective measures of animal science knowledge and pre-college performance scores for students enrolled in Animal Science 140 at Western Kentucky University\(^1\)

<table>
<thead>
<tr>
<th></th>
<th>English(^{10})</th>
<th>Math(^{11})</th>
<th>Read(^{12})</th>
<th>Sci.(^{13})</th>
<th>Comp(^{14})</th>
<th>Hspile(^{15})</th>
<th>HSGPA(^{16})</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>86</td>
<td>86</td>
<td>86</td>
<td>86</td>
<td>86</td>
<td>71</td>
<td>82</td>
</tr>
<tr>
<td>ABA(^2)</td>
<td>.13</td>
<td>-.07</td>
<td>.25(^{a})</td>
<td>.13</td>
<td>.16</td>
<td>.18</td>
<td>.06</td>
</tr>
<tr>
<td>AEA(^3)</td>
<td>.07</td>
<td>.06</td>
<td>.13</td>
<td>.09</td>
<td>.11</td>
<td>.16</td>
<td>.15</td>
</tr>
<tr>
<td>AI(^4)</td>
<td>-.10</td>
<td>.11</td>
<td>-.18(^{c})</td>
<td>-.09</td>
<td>-.10</td>
<td>-.09</td>
<td>.02</td>
</tr>
<tr>
<td>ITS(^5)</td>
<td>.11</td>
<td>.22(^{b})</td>
<td>.26(^{a})</td>
<td>.21(^{b})</td>
<td>.22(^{b})</td>
<td>.27(^{b})</td>
<td>.21(^{b})</td>
</tr>
<tr>
<td>LDTS(^6)</td>
<td>.21(^{b})</td>
<td>.36(^{a})</td>
<td>.19(^{e})</td>
<td>.36(^{a})</td>
<td>.29(^{a})</td>
<td>.43(^{a})</td>
<td>.33(^{a})</td>
</tr>
<tr>
<td>TI(^7)</td>
<td>.11</td>
<td>.16</td>
<td>-.03</td>
<td>.17</td>
<td>.09</td>
<td>.19</td>
<td>.14</td>
</tr>
<tr>
<td>FTS(^8)</td>
<td>.30(^{a})</td>
<td>.47(^{a})</td>
<td>.28(^{a})</td>
<td>.44(^{a})</td>
<td>.39(^{a})</td>
<td>.52(^{a})</td>
<td>.47(^{a})</td>
</tr>
<tr>
<td>FA(^9)</td>
<td>.36(^{a})</td>
<td>.51(^{a})</td>
<td>.37(^{a})</td>
<td>.51(^{a})</td>
<td>.46(^{a})</td>
<td>.60(^{a})</td>
<td>.57(^{a})</td>
</tr>
<tr>
<td>Lab Grade</td>
<td>.25(n = 42)</td>
<td>.49(n = 42)</td>
<td>.39(n = 42)</td>
<td>.51(n = 42)</td>
<td>.44(n = 42)</td>
<td>.60(n = 39)</td>
<td>.57(n = 41)</td>
</tr>
</tbody>
</table>

\(^{1}\) a = p < .01, \(^{b}\) = p < .05, \(^{c}\) = p < .10

\(^{2}\) Average beginning assessment = ABA

\(^{3}\) Average ending assessment = AEA

\(^{4}\) Average improvement = AI

\(^{5}\) Initial test score = ITS

\(^{6}\) Last day test score = LDTS

\(^{7}\) Test improvement = TI

\(^{8}\) Final test score = FTS

\(^{9}\) Final average = FA

\(^{10}\) ACT English = English

\(^{11}\) ACT math = Math

\(^{12}\) ACT reading = Read

\(^{13}\) ACT science = Sci

\(^{14}\) ACT composite = Comp

\(^{15}\) High school percentile rank within class = Hspile

\(^{16}\) High school grade point average = HSGPA
| Table 16. Coefficients of correlation between female subjective and objective measures of animal science knowledge and pre-college performance scores for students enrolled in Animal Science 140 at Western Kentucky University\(^1\) |
|---|---|---|---|---|---|---|---|
| | English\(^{16}\) & Math\(^{11}\) & Read\(^{12}\) & Sci.\(^{13}\) & Comp\(^{14}\) & Hspile\(^{15}\) & HSGPA\(^{16}\) |
| N | 93 & 93 & 93 & 93 & 93 & 73 & 86 |
| ABA\(^2\) & .12 & .08 & .09 & .16 & .14 & .03 & -.005 |
| AEA\(^3\) & .23\(^b\) & .17 & .17\(^c\) & .16 & .23\(^b\) & .11 & .09 |
| AI\(^4\) & .01 & .02 & .02 & -.06 & -.003 & .04 & .06 |
| ITS\(^5\) & .41\(^a\) & .36\(^a\) & .45\(^a\) & .45\(^a\) & .48\(^a\) & .30\(^a\) & .22\(^b\) |
| LDTS\(^6\) & .31\(^a\) & .38\(^a\) & .35\(^a\) & .33\(^a\) & .39\(^a\) & .38\(^a\) & .37\(^a\) |
| TI\(^7\) & -.006 & .11 & .01 & -.01 & .02 & .16 & .22\(^b\) |
| FTS\(^8\) & .55\(^a\) & .55\(^a\) & .56\(^a\) & .54 & .63\(^a\) & .50\(^a\) & .49\(^a\) |
| FA\(^9\) & .58\(^a\) & .57\(^a\) & .57\(^a\) & .57\(^a\) & .64\(^a\) & .63\(^a\) & .59\(^a\) |
| Lab Grade & .51\(^a\) & .52\(^a\) & .48\(^a\) & .52\(^a\) & .60\(^a\) & .57\(^a\) & .54\(^a\) |

\(^1\) a = p < .01, b = p < .05, c = p < .10

\(^2\) Average beginning assessment = ABA

\(^3\) Average ending assessment = AEA

\(^4\) Average improvement = AI

\(^5\) Initial test score = ITS

\(^6\) Last day test score = LDTS

\(^7\) Test improvement = TI

\(^8\) Final test score = FTS

\(^9\) Final average = FA

\(^{10}\) ACT english = English

\(^{11}\) ACT math = Math

\(^{12}\) ACT reading = Read

\(^{13}\) ACT science = Sci

\(^{14}\) ACT composite = Comp

\(^{15}\) High school percentile rank within class = Hspile

\(^{16}\) High school grade point average = HSGPA


Cross, K. Patricia. 1998. What do we know about Students’ Learning and how do we know it? Keynote address to 1998 AAHE National Conference on Higher Education.


