

A retention comparison of Agxactly, an interactive quiz game, versus traditional review methods in post-secondary education

by Lucas Seth Porter

A thesis submitted in partial fulfillment of the requirements for the degree of Masters of Science in Agricultural Education
Montana State University
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Abstract:
The purpose of this study was to determine the effect of the use of AgXactly, an interactive quiz game, incorporating time parameters, point values, and teamwork as a means to temper concepts and knowledge, and as a review tool on content related to Montana State University's Introduction to Animal Science course.

This study was conducted using the Solomon Four research design. Participants in this study were those students enrolled in MSU's Animal and Range Natural Resources 100 course spring semester of 2003. Participants were exposed to either a traditional review or review via the means of playing AgXactly. Data was collected using a demand knowledge pretest and posttest. A survey instrument was used to determine students' perceptions of the use of games for education and revision.

Data collected indicated that there was no difference on knowledge retention as evidenced by posttest performance between the control and experimental groups. Results of the survey indicated that the use of games as review was seen as beneficial by the students.

Based on these findings the researcher drew the conclusion that while games had no statistically significant effect on test performance, student motivation was increased. Another benefit from using AgXactly was increased student interaction. It is recommended that further research be undertaken to determine the effect of games on student motivation.

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APPROVAL

of a thesis submitted by

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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ABSTRACT

The purpose of this study was to determine the effect of the use of AgXactly, an interactive quiz game, incorporating time parameters, point values, and teamwork as a means to temper concepts and knowledge, and as a review tool on content related to Montana State University's Introduction to Animal Science course.

This study was conducted using the Solomon Four research design. Participants in this study were those students enrolled in MSU's Animal and Range Natural Resources 100 course spring semester of 2003. Participants were exposed to either a traditional review or review via the means of playing AgXactly. Data was collected using a demand knowledge pretest and posttest. A survey instrument was used to determine students' perceptions of the use of games for education and revision.

Data collected indicated that there was no difference on knowledge retention as evidenced by posttest performance between the control and experimental groups. Results of the survey indicated that the use of games as review was seen as beneficial by the students.

Based on these findings the researcher drew the conclusion that while games had no statistically significant effect on test performance, student motivation was increased. Another benefit from using AgXactly was increased student interaction. It is recommended that further research be undertaken to determine the effect of games on student motivation.

INTRODUCTION

Advances in technology have allowed us to rise to our present high standard of living. Innovations such as the printing press, internal combustion engine, television, computers, and the Internet have irrevocably changed our society (Marrison, 1992). These technological advances have not only benefited society as a whole, but also more specifically these advances and innovations have benefited the educational field. Wegner, Holloway, and Garton (1999) stated,

> "The practice of using technology to deliver coursework in higher education has seen a veritable explosion. The use of technology has not only created new opportunities within the traditional classroom but has also served to expand learning experiences beyond the popular notion of 'classroom.' Indeed, 'distance learning,' especially utilization of the Internet, is becoming a widely used delivery alternative at universities nationwide." (p 1).

Numerous studies have shown people possess a variety of learning styles (Kagan, Rosman, Day, Albert, and Phillips, 1964; Bjorklund, 1989; Witkin, Moores, Goodenough and Cox, 1977). Some students respond best to oral communication, while others require a visual medium in order to incorporate information. Educators should strive to utilize as many instruction styles as possible to effectively instruct the largest audience possible. Multimedia instruction provides a unique format in order to achieve this goal. Multimedia instruction appeals to visual learners via animation, graphics, and written text and it appeals to the aural learner by utilizing sounds and the spoken word.

While multimedia is a valuable teaching tool, it is not a panacea. An effective instructor must not only present the information in a viable way, but must also motivate the student's desire to learn. Many techniques have been developed to improve

motivation. The use of games and activities is one example of means to increase motivation. Allowing the students to actively shape the content of the course would be another motivational method.

The focus of this study was to determine the effectiveness of games that encourage learning among participants. Games have been designed to appeal to the students' competitive nature as well as incorporating "fun" into the lesson. It has been shown that play performs an important role in psychological, social, and intellectual development while being intrinsically motivating (Rieber, 1996).

Purpose of Study

The purpose of this study was to determine the effect of the use of AgXactly, an interactive quiz game, incorporating time parameters, point values, and teamwork as a means to temper concepts and knowledge, and as a review tool on content related to Montana State University's Spring 2003 Introduction to Animal Science course.

Need for Study

Recent advances in technology, specifically in the field of computers, have allowed for the expansion of gaming as an instructional tool. Amory, Naicker, Vincent, and Adams (1999) stated:

> "The advent of personal computers with superior graphics systems has precipitated an explosion in game software. This multimillion-pound industry produces many different kinds of games ranging from simulations through to first-person adventures. Here players are immersed into virtual worlds filled with stunning graphics, compelling, if not addictive, story lines, sound and video." (p 312).

Numerous studies (Nemerow, 1996; Bell, 1982; Randel and Morris, 1992) have shown that gaming enhances learning. Positive effects on students were increased self-esteem, decreased time needed to absorb information, and decreased test anxiety.

This study sought to increase knowledge regarding the effectiveness of gaming as a review tool. Past research focused on using games for instruction (Nemerow, 1996; Hewitt, 1997; Haught, Kunce, Pratt, Werneske, and Zemel, 2002). Meanwhile little research has been done on games as a means of review (Bell, 1982; Dechristopher, 1991) Due to the lack of research base on games as a means of review this study focused on games as a reinforcement of material presented in the classroom.

Objectives

The objectives of this study were:

1. To determine the effects of AgXactly, an interactive quiz game, as a review tool on academic achievement as shown by scores on the posttest;
2. To determine students' perception of the effectiveness of AgXactly, an interactive quiz game, as a review tool compared to traditional review;
3. To determine the relationship between demographic variables in the AgXactly review group and their posttest performance.

Hypotheses

The null hypotheses for this study were:

H_o1. The use of AgXactly, an interactive quiz game, as a review tool will have no statistically significant affect on knowledge retention levels in the short term;

H_o2. Students' perception of the effectiveness of AgXactly, an interactive quiz game, as a review tool will not vary significantly from their perceptions of traditional review.

Assumptions

The assumptions guiding this study were:

1. Students performed their best on the animal science pretests and posttests.
2. Students in the treatment group did not share information with the control group.
3. Students responded honestly about their perception of the effectiveness of an interactive quiz game as a review tool.
4. Students performed optimally during the traditional lecture instruction.
5. The use of AgXactly had an effect on academic achievement.

Limitations

The following limitations applied to this study:

1. The sample population was students enrolled in the Introduction to Animal Science course at Montana State University Spring 2003 semester.
2. The participants' prior knowledge of animal science topics may have had an affect on test scores.

Definition of Terms

The following terms are defined in order to dispel confusion as to their meaning as they pertained to this study:

Computer Multimedia:	computer application that can incorporate the use of text, video, graphics, animation, audio, and still pictures to convey a message (Marrison, 1992).
Traditional Instruction:	method of instruction in which the instructor presents concepts and information about the discussion topic. Supplemental methods of instruction would include overheads, and chalkboard writing (Marrison, 1992).
Game:	an activity in which participants follow prescribed rules that differ from those of reality as they strive to attain a challenging goal (Instructional Media: 7th edition 2001)
AgXactly:	an interactive quiz game incorporating time parameters, point values, and teamwork (W. Lanier personal communication November 2002).
Internet:	an electronic communications network that connects computer networks and organizational computer facilities around the world (Miriam-Webster 2002).

A REVIEW OF LITERATURE

The History of Computers

In our technologically driven society we have become increasingly dependent on computers. The first true computer was the ENIAC which was developed in the late 1940's at the University of Pennsylvania. ENIAC allowed for rapid and accurate calculations; however, it also had limitations. It was bulky in size and required a large investment of man-hours to reprogram it for new problems.

Since the inception of the computer industry revisions and advances have been phenomenal over the years. Speed of operation has increased many times over. Smaller, faster, and more efficient components have lead us a long way from the days of vacuum tubes. Along with this increase in power and reduction in size, prices have dropped to the point where computers are economically viable for use in industry and for the average citizen. Computers have become an integral part of our everyday lives. Computer technology helps to run the alarm clock that wakes us up. It helps to regulate the operation of our vehicles as we go to work and is present to some extent in almost every industry.

Considering how the computer has invaded almost every aspect of our lives it makes sense that the education field would also incorporate computer technology. Just as computers have become an integral part of society so too have they become integral to education. Schools use computers for administrative functions such as record keeping. The individual teacher uses them for development of lesson plans, handouts,

slides, and overheads. With the invention of the Internet computers are extensively used for research. The majority of students now are more comfortable surfing the web for resources than negotiating the stacks in a library.

Based on all these indirect uses of computers in the classroom it only makes sense that computers should enter directly into the classroom setting itself as indeed they have. Kulik and Kulik (1987) concluded the following about the use of computers in education:

1. Students generally learned more in classes when they received instructional help from computers.
2. Instructional time was decreased.
3. Students perceived their classes to be more enjoyable.
4. Students developed more positive attitudes toward computers. (p 123).

Another form of computer driven technology that is becoming widespread in an educational setting is Internet based instruction. The use of the Internet in the classroom has allowed for easy access to an array of information. In addition to this it has allowed for the 'classroom' itself to expand via distance education. This allows the student the opportunity to take classes not previously offered such as classes for college credit or classes in more obscure subjects. In many cases the impact of this new technology on students has not been considered. Wegner, Holloway, and Garton (1999) conducted a study to determine the effects of distance learning on student achievement as well as student attitudes concerning their learning experiences. The study focused on a curriculum design and evaluation course. The students were divided into a traditional lecture group and an experimental group which received instruction via e-mail and video conferencing. No difference in knowledge retention as evidenced by test scores was

found. However, those students in the experimental group possessed a more positive feeling about the experience. In this respect distance education is similar to games in education. In general no difference in test performance is found but increased motivation is found among those using the new technology.

There are three main ways in which the computer enters the classroom. The most common is using computers to run PowerPoint presentations. This has become a common means of providing lecture material in a multimedia format. The instructor is able to incorporate, visual, audio, still pictures, and video clips in one package. This allows the instructor to appeal to a wide range of learning styles and thus makes the lecture more efficient. Frey and Birnbaum (2002) undertook research to determine students' attitudes towards PowerPoint presentations. Undergraduate students (n=160) at the University of Pittsburgh completed surveys regarding their perceptions of the use of PowerPoint as a lecture format. Results indicated that students felt PowerPoint lectures were advantageous to the student as opposed to traditional lecture. Reasons cited for this was increased ease of note taking and professors who used PowerPoint were perceived as better organized. Another interesting finding from this research was that students did not see making lecture material available beforehand as a detriment to class attendance.

The second major use of computers is as tutorials. There is an array of programs out there which walk students through set topics. The third use and the focus of this paper is the use of computers to run instructional games.

Effectiveness of Games in Education

Randel and Morris (1992) stated: "Because many students enjoy playing games, it has often been asked whether this play aspect could be combined with instruction to enhance learning. This observation led educators to explore the feasibility of using a game format to supplement or replace the teaching of a variety of subjects." (p 261).

The theory of combining play with instruction to enhance learning has subsequently been applied and met with mixed results. There are many examples of research that has found gaming to be an effective means of instruction (Amory et. al., 1999; Nemerow, 1996; Randel and Morris, 1992; Hewitt, 1997). In many cases it has been found that it is not a matter of the game itself being a more effective means of increasing student retention, but rather some interesting side effects of games which cause increased student performance. Games provide a fun and stimulating means of instruction. An effective educator must present information in a clear and concise manner and attempt to also motivate the student's desire to learn the information. Making learning fun can increase motivation and make the learning process more effective (Lepper and Cordova, 1992). Lepper continued to be instrumental in the field of increasing student motivation through gaming technology by operating a company which designs motivational games to aid in learning math skills (Azer, 1998). Johnson and Johnson (1987) reported that the use of games in classrooms stimulated a positive influence on student's attitudes towards school personnel, motivation to learn, self-esteem, and behavior.

Oftentimes there arises confusion between games and simulations. They are often considered one and the same but while they share some elements they are distinct entities. Gredler (1994) defined and classified various elements found in games and simulations. Both games and simulations transport the players or participants to another world. The players and participants control the actions within the set limits of the game/simulation environment.

Games and simulations also vary in three ways. Games are competitive whereas simulations assign responsibilities to students and are faced with the associated rewards and consequences as a result of their decisions. The event sequence also tends to vary between games and simulations. Games are arranged linearly while simulations are not. Games are more static in nature. They are based on a set of rules which does not change over time. Simulations deal with a set of dynamic relationships that may change over time.

Gredler (1994) also defined certain characteristics as key components of games that are appropriate for classroom use. Games should not sanction questionable ethics or practices. Chance should not contribute to winning. An emphasis must be placed on the application of knowledge or problem solving skills as the means of winning.

Gredler (1994) also touched upon the balancing of competition and cooperation in game usage. Gredler (1994) emphasized that while competition is of the essence of any game, it must be balanced with the need for stimulating cooperation among students to foster a positive classroom environment.

Devries and Slavin (1978) conducted a series of ten experiments incorporating a system of forming students into teams and then having those teams participate in a series of games and tournaments. In summarizing their findings they stated: "TGT (Teams-Games-Tournaments) had relatively consistent positive effects (when compared to traditional instruction) on academic achievement, mutual concern, race relations, and peer norms supportive of academic achievement." (p 36).

Whiteley and Faria (1989) conducted a review of literature concerning the use of simulation games, with a focus on business games, in the collegiate setting. This study focused solely on whether incorporating a business simulation game into a marketing course improved acquisition of marketing knowledge. It was determined that overall the game participation had no effect on exam performance but the game playing group performed above the non-game playing group with respect to quantitative questions.

A review of studies on differences between simulations/games and conventional instruction in student performance by Randel and Morris (1992) found the following conclusions:

1. 56% found no difference.
2. 32% found differences favoring simulations/games.
3. 7% favored games but had questionable controls.
4. 5% found differences favoring conventional instruction.
5. Stimulations/games show greater retention over time than conventional classroom instruction.
6. Students reported more interest in simulation and game activities than in more conventional classroom instruction.

7. Games can provide a viable means of reinforcing cooperative skills. By structuring the game so that working in a group leads to success the administrator strengthens team-building skills. In this manner students further develop their interpersonal skills. (p 265).

Marrison (1992) undertook a research project comparing computer multimedia instruction versus traditional instruction in post-secondary education at Purdue University. The participants were students enrolled in an introductory agricultural economics course. It was discovered that there was no difference in academic achievement as judged by test scores in those students taught by computer multimedia and those taught by traditional lecture. Student learning time was decreased by 32 percent for those students taught by computer multimedia. Student learning styles, field dependent/independent, were also considered. No significant difference was found between learning styles, instructional method, and test performance.

Nemerow (1996) experimented with incorporating a variety of games into a high school first year biology course. Among these were question and answer games, strategy games, word games, and noncompetitive games. Surveys were used to assess students' perceptions of games in education. The surveys varied but three questions were always included in each survey. These three questions were: Do you feel that games helped you learn? ; Did playing the game help you gain confidence in yourself? ; Did you learn some information that you did not already know? Student responses indicated that they felt a higher level of self-confidence as a result of the game. One key word that kept being repeated was that students had "fun". This lead to increased participation which implies that student motivation was increased. Students also reported that the games lead to

increased interaction with their peers and as a result of that positive relationships were established among the students.

Hewitt (1997) conducted research among Midwestern fourth, fifth, and sixth graders (n=295) on the use of games in education as a means of encouraging environmentally responsible behavior. A series of six games designed to educate student about environmentally responsible behavior were incorporated into classroom curricula. Results found that scores significantly increased from pretest to posttest for four of the six games. This provides one example where the use of games in education has produced a positive effect on test scores.

Amory, Naicker, Vincent, and Adams (1999) considered four different commercial games in an attempt to identify the game type most suitable for the classroom. They considered four commercial games: a 3-D adventure (a typical shoot-em-up game), a strategy game, simulation game, and another less violent adventure game. The population observed was first and second year college students. Findings indicated that the students preferred 3-D adventure and strategy games. The key elements which appealed to the students were graphics, sound, and story lines. It was their opinion that skills such as visualization, logic, and memory were important skills to possess in order to be successful.

Haught, Kunce, Pratt, Weneske, and Zemel (2002) conducted research to improve student proficiency in learning and retaining basic mathematics facts. The study focused on elementary school students in four midwestern schools. Several strategies were implemented, one of which was the use of games as instruction. Increased test

performance when comparing pretest-posttest performance was reported for the gaming instruction group.

Research has also been conducted on games as a review method. Bell (1982) reports on STRATAGEM: A problem solving game used for revision. Students reported the following benefits:

1. An understanding of the breadth and scope of the major ideas in the subject.
2. Decreased anxiety with regard to later study for term examinations.
3. Corrections of erroneous initial learning of concepts in the subject.
4. Opportunities to weigh alternative ideas. (p 163).

While this review game shares many attributes with AgXactly, it differs in that it was not computer driven. It used a series of flash cards and was conducted under a different format.

A practical application of a Jeopardy formatted review game was used by DeChristopher (1991). Dechristoper (1991) designed a jeopardy style quiz game for use in her high school science classroom. While this was not an actual research study it demonstrated that review games being used in the classroom can have a positive effect. DeChristopher (1991) noted that Science Jeopardy did not involve higher-level thinking skills, but it did make learning basic terms exciting for the students (p 37).

METHODOLOGY

Population and Sample

The study population (n=129) consisted of undergraduate students enrolled in MSU's Animal and Range Natural Resources (ARNR) 100 course spring semester of 2003. This is MSU's introductory animal science course. Topics covered include basic principles of animal genetics, nutrition, live animal evaluation, reproduction, and applications of these principles to the production of beef and dairy cattle, sheep, swine, horses, and poultry. This study used the topics of beef cattle production, sheep production, disease and adaptation, lactation, and horse production to conduct research.

The ARNR 100 students were selected, as this course is available to a wide variety of freshman enrolled in the College of Agriculture. Thus, a wide breadth and diversity of agricultural students were available.

Design

A Solomon four group research design was used in this study. Study design can be represented by the following illustration:

Group 1	R	O	X	P
Group 2	R		X	P
Group 3	R	O		P
Group 4	R			P

The symbols are defined as follows:

R	Randomization	P	Posttest
O	Pretest	X	Treatment

The major dependent variable was the students' academic achievement scores on the posttest. The major independent variable was whether students participated in an AgXactly review session or were exposed to traditional review to prepare for the posttests.

Borg, Gall, and Gall (1996, p 466) recognized twelve threats to internal validity. These threats are: history, maturation, testing, instrumentation, statistical regression, differential selection, experimental mortality, selection-maturation interaction, experimental treatment diffusion, compensatory rivalry by the control group, compensatory equalization of treatments, and resentful demoralization of the control group.

History refers to factors outside of the experiment which may affect the dependent variable. The short duration of this study minimized this effect.

Maturation refers to physical and psychological changes occurring in the study participants over time. The short time frame in which this study occurs along with randomization of the groups minimized this problem.

The use of pretests may cause participants to become "test wise". That is to say they may show inaccurately high levels of academic achievement on the posttest due to similarities between the pretest and posttest rather than due to an increase in knowledge.

The Solomon Four research design is meant to counter this, as half of the participants were not pretested. Providing a control group with which to compare.

Instrumentation refers to a learning gain that might be observed from pretest to posttest because the nature of the measuring instrument has changed (Borg, Gall, and Gal,l 1996). The use of a control group and the testing of both groups under the same conditions controlled for this threat to validity.

Statistical regression is a tendency for research participants whose scores fall at either extreme on a variable to score near the mean when the variable is measured a second time (Borg, Gall, and Gall, 1996, p 469). The random assignment of the groups countered this.

Differential selection refers to pre-existing differences between control and experimental groups having effects on the dependent variable that are unrelated to the independent variable. The randomization of groups in this study controlled this threat.

Mortality refers to participants dropping out of the study. Due to the short duration of this study this threat was eliminated.

Selection maturation interaction refers to the problem of differing levels of maturity between groups and may skew research results. This threat will exist to a small extent although the majority of participants will be from the same socio-economic background and thus share similar experiences which will have most likely caused them to mature in approximately the same manner and at the same level. Randomization countered what maturity variances were present.

Experimental treatment diffusion refers to the situation where the control group sees the treatment as advantageous and thus seeks to gain access to it. This will be controlled in this study by not allowing the participants to know if they were in the experimental or the control group until just prior to treatment.

Compensatory rivalry occurs when the control group realizes they are part of an experiment and thus perform beyond their normal abilities. This was controlled by not allowing participants to know what group they were in until just prior to testing.

Compensatory equalization occurs when the experimental group is perceived to be receiving advantageous treatment compared to the control group. The researcher may unknowingly compensate by giving the control group a lower level of treatment. Thus the researcher is no longer comparing treatment to no treatment but rather is comparing two treatments. This was a valid threat for this study as the control group did receive a treatment in the forms of a traditional review. However, due to the nature of this study it was necessary to give this treatment. Otherwise, the research would be comparing a means of review versus no review at all.

Resentful demoralization occurs when the control group feels the experimental group is receiving advantageous treatment and thus become demoralized. This will be controlled for by not allowing participants to know what group they are in prior to treatment.

Gay (1987) recognized three threats to external validity which are of concern in this study. These threats are: pretest treatment interaction, reactive arrangements, and experimental effects.

Pretest treatment interaction is similar to testwiseness. It occurs when participants score differently on posttests than they otherwise would due to the fact that they have been pretested. The Solomon Four research design allowed for correction of pretest treatment interaction.

Reactive effects refer to a number of factors associated with the way a study is conducted and feelings and attitudes of the subjects involved (Gay 1987). These threats were minimized by randomization of participants.

Experimental effects refer to any active or passive bias on the part of the researcher as regards to passive elements such as age, sex, or race. Evaluating the test scores on an anonymous basis eliminated this form of bias.

Instrumentation

Instruments used to collect data were a pretest, posttest, and perceptions survey. The pretest and posttest were designed by the researcher and reviewed by Raymond Ansotegui, the professor who teaches Animal and Range Natural Resources 100, Introduction to Animal Science. The purpose of the tests was to determine participants' level of knowledge regarding content taught in ARNR 100, specifically the course content dealing with beef cattle production, sheep production, disease and adaptation, lactation, and horse production. Both the pretest and posttest consisted of ten multiple choice questions designed to test for retention of key concepts taught in selected course subjects. These tests can be found in Appendix A. The perceptions survey consisted of demographic information, questions concerning computer ownership and use, and

twenty-four questions regarding students' perception of AgXactly. Students filled in the appropriate demographic information and responded to the questions in the form of a Likert-type scale. A copy of the perceptions survey can be found in Appendix B.

Pilot Study

A pilot study was conducted on Tuesday, February 18, 2003. The population for this study was MSU's Spring 2003 ARNR 422 Beef Nutrition course taught by Dr. Janice Bowman. The content tested consisted of the nutrition portion of ARNR 100 course. This included monogastric nutrition, ruminant nutrition, and anatomy of the digestive tract for monogastrics, ruminants, and poultry. All students in this course completed the pretest, participated in a 30 minute AgXactly review session, and then completed the posttest and perceptions survey.

Data Collection

All testing in ARNR 100 occurred on Wednesday, April 7, 2003. The students were randomly assigned to one of four groups. This process consisted of counting the students off into four groups as they sat in their classroom seat. In other words, the researcher went around the room counting one, two, three, four; one, two, three, four, etc. There was not an assigned seating chart for the ARNR 100 course. Those two groups taking the pretest were isolated from their peers and completed the AgXactly Research Pretest. The groups were then separated into those being exposed to the traditional review and those reviewing via an AgXactly session. Forty-five minutes were allocated

review and those reviewing via an AgXactly session. Forty-five minutes were allocated for both the traditional and AgXactly review sessions. The traditional review consisted of a PowerPoint presentation designed by the researcher and conducted by a research associate who was trained by the researcher for this purpose. This presentation can be found in Appendix F. The AgXactly review session was conducted under the guidance of the researcher. The complete question database used in this session can be found in Appendix G. Upon termination of the review session the posttest was administered to all participants and those students who participated in the AgXactly review session completed a perceptions survey regarding the effectiveness of AgXactly, an interactive quiz game as a means of review. This perceptions survey is found in Appendix B.

Data Analysis

Data collected were scored, coded and entered into an Excel spreadsheet. The Statistical Package for the Social Sciences (SPSS 11.5) was used to analyze the data:

1. The pretest, posttest, and perception survey were all analyzed for reliability. Cronbach's Coefficient alpha was used to analyze the perceptions survey. The pretest and posttest were analyzed using a split half measure of reliability.

2. A 2 X 2 factorial analysis of variance was used to determine the effects of an interactive quiz game as a review tool on knowledge retention levels of ARNR 100 students. The factors for study were two levels of testing (i.e., pretest or posttest) and two levels of treatment (i.e., review game session vs. non-review game session). A one between, one within repeated measures factorial analysis of variance was used to determine the knowledge retention level of those groups that were pretested and post tested on the ARNR 100 exam.

3. Those questions on the perceptions survey which were worded negatively were recoded for purposes of analysis.

4. Descriptive statistics were utilized to analyze data from the perceptions survey.

5. Independent sample t-tests were used to compare demographic information to test performance.

6. A one-way ANOVA was used to compare size of high school to test performance.

7. A one-way ANOVA was used to compare age to test performance.

Instrument Reliability and Validation

Measures of reliability of the pretest and posttest were found using a Split-Half measure of reliability. The data used to compile these coefficients was the pretest and posttest scores from the actual research study. A reliability coefficient of .4831 was found for the pretest. The posttest reported a reliability coefficient of .2663. Both of these were rather low, but this may be explained in part by the short length of the tests and also the fact that they cover multiple subjects. While the entire test is all based on animal science topics, this is further broke down to the components of beef production, horse production, sheep production, and disease and adaptation. The range of subtopics included within the tests is also a contributing factor to the low reliability coefficients reported. However, an examination of the regular course exams shows that the AgXactly Pretest and Posttest cover the same material as determined by the ARNR 100 instructor. The perception survey was analyzed for reliability using Cronbach's alpha measure of reliability and a coefficient of .9093 was found.

FINDINGS

The study population (n=129) consisted of students enrolled in Montana State University's Animal and Range Natural Resources 100, Introduction to Animal Science, Spring 2003. Due to student absences on the testing day this population was reduced to a sample size of 80. Of this sample 55% (n=44) were female, and 45% (n=36) were male. Table 1 illustrates the gender distribution after random division into treatment and control groups.

Table 1. Gender Distribution of Study Group.

Control Group	
60% (n=21) female	40% (n=14) male
Experimental Group	
51% (n=23) female	49% (n=22) male

The majority of students 77% (n=62) were enrolled in the College of Agriculture. Academic majors varied from a high of 28.75% (n=23) in Animal Science followed by Agricultural Education 13.75% (n=11), Agricultural Business 13.75% (n=11), General Studies 11.25% (n=9), Range Science 7.5% (n=6), Agricultural Operations Technology 7.5% (n=6), Pre-Veterinary science 6.25% (n=5), Business 3.75% (n=3). The low of 1.25% (n=1) was represented in each of the following majors: Elementary Education, Cell Biology, General Agriculture, Human Health and Development, National Student Exchange, and Non-degree Undergraduate. Table 2 presents the distribution of majors within the ARNR 100 course.

Table 2. Majors of Students in ARN 100.

Major	Frequency	Percent
Animal Science	23	28.75
Agricultural Education	11	13.75
Agricultural Business	11	13.75
General Studies	9	11.25
Range Science	6	7.50
Agricultural Operations Technology	6	7.50
Pre-Veterinary Science	5	6.25
Business	3	3.75
Elementary Education	1	1.25
Cell Biology	1	1.25
General Agriculture	1	1.25
Human Health and Development	1	1.25
National Student Exchange	1	1.25
Non-degree Undergraduate	1	1.25

Further demographic information was collected from those students in the experimental group. This consisted of age, computer usage, past experiences with computers, urban vs. rural upbringing, 4-H and FFA involvement, and size of high school. This data was collected in order to achieve objective three which was to determine the relationship between demographic variables in the AgXactly review group and their posttest performance.

Age ranged from 18 to 26 with the majority 46%, (n=21) being 19. Table 3 shows the complete age distribution within the ARNR 100 course.

Table 3. Age Distribution of AgXactly Group.

Age	Frequency	Percent
18	6	13.3
19	21	46.7
20	4	8.9
21	7	15.6
22	2	4.4
23	1	2.2
26	1	2.2
Missing	3	6.7

Students were asked to indicate computer ownership and use. The majority 78% (n=35) reported that they own a computer. Thirty-eight percent (n=17) reported using school computers. None reported renting a computer. Nine percent (n=4) stated that they plan to purchase a computer. Twenty percent (n=9) reported using a friend or acquaintances computer.

Students rated their perceptions of past experiences with computers in middle school, high school, and college. Responses were in the form of a Likert-type scale with 5 representing very good past experiences and 1 representing very poor past experiences. Complete frequency tables for all three questions can be found in Appendix C. Table 4 illustrates the mean responses for all three categories. Overall students rated experience with computers in middle school as neutral (Mean = 2.9 std. 1.51), while experiences in high school (Mean = 3.52 std. 1.55) and college (Mean = 3.74 std. 1.51) were good.

Table 4. Perceptions of Past Experiences with Computer in Education.

Education Level	Mean*	Standard Deviation
Middle School	2.9	1.51
High School	3.52	1.55
College	3.74	1.51

*Scale of Convections Used: 5.00-4.50, Very good, 4.50-3.50 Good, 3.49-2.50 Neutral, 2.49-1.50 Poor, 1.49-1.00 Very Poor

When asked if they had grown up in an urban or a rural setting, all but one of the students (n= 44) replied that they considered their home a rural setting.

Data regarding 4-H or FFA involvement was collected. Slightly more than half, 53.3 % (n=24) had been involved in 4-H to some degree. Slightly less than half, 48.9% (n=22) had been involved in the FFA organization. Forty percent (n=17) had been

involved in both 4-H and FFA. Thirty percent (n=14) had been involved in neither 4-H or FFA.

Size of high school was also recorded. Responses ranged from a minimum of 24 to a maximum of 1500. The mean was 394.57 with a standard deviation of 422. Due to the wide variance in school size the overall sample was broken into four groups. Thirteen percent of the students came from a school ranging in size from 24 to 57.5 students. Thirty eight percent of the students came from a school ranging in size from 58 to 300 students. Twenty two percent of the students came from a school ranging in size from 301 to 500 students. Twenty six percent of the students came from a school ranging in size from 501 to 1500 students. Table 5 displays the frequency of school sizes.

Table 5. High School Size Frequencies.

Number of Students	Frequency	Percent
Missing	4	8.9
24	1	2.2
25	2	4.4
45	1	2.2
48	1	2.2
50	1	2.2
60	1	2.2
80	1	2.2
100	1	2.2
120	2	4.4
150	1	2.2
175	1	2.2
200	3	6.7
300	2	4.4
350	2	4.4
400	5	11.1
450	1	2.2
500	3	6.7
700	2	4.4
800	2	4.4
1000	1	2.2
1200	1	2.2
1500	3	6.7

Academic Achievement Analysis

As described in Chapter 3 the sample was divided into four groups. Groups one and three completed the pretest. After the sample received the two treatments all four groups took the posttest. Both pretest and posttest were analyzed for reliability using the split half reliability measure. The pretest had a reliability coefficient of .4831 according to the Spearman-Brown equation, and the posttest had a reliability coefficient of .2663.

The mean values on the pretest varied from 6.75 to 6.85. The traditional pretest-posttest group had a pretest mean of 6.75 with standard deviation of 1.80. The AgXactly pretest posttest group had a pretest mean of 6.85 with a standard deviation of 1.69.

The mean values on the posttest for all four groups ranged from a minimum of 6.80 to a maximum of 7.26. Table 6 shows the mean and standard deviation for the four groups.

Table 6. Pretest and Posttest Mean Scores.

Treatment	Test condition	Pretest Mean	Posttest Mean	Std. Deviation
Traditional	Pretest- Posttest	6.75	7.25	1.65
	Posttest Only		7.26	2.07
Game	Pretest-Posttest	6.85	7.10	1.02
	Posttest Only		6.80	1.47

A 2 X 2 factorial analysis of variance was conducted to determine the effects of using AgXactly on academic achievement as measured by the posttest scores. The factors consisted of two levels of the game condition (used the game or did not use the game) and test condition (pretest or no pretest). Results from this analysis found that there was no difference on the achievement measure between groups of ARNR 100

students who used AgXactly for review and those who did not, $F_{(1, 76)} = .731, p=.395$. In addition, there was no difference on mean achievement scores between those students who completed the pretest and those who did not, $F_{(1, 76)} = .160, p = .690$. Table 7 presents these findings.

Table 7. Tests of Between-Subjects Effects.

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Treatment	1.833	1	1.833	.731	.395
Test Condition	.401	1	.401	.160	.690
Error	190.484	76	2.506		

Perception Survey Findings

The 45 students in the AgXactly treatment group completed a 24-question survey regarding their perceptions of AgXactly and their general perceptions of computers as review tools in general. In regards to all questions the students responded on a 5-point Likert-type scale. Five represented strong agreement and one signified strong disagreement with the question statement. Overall the responses were positive towards the use of computer games as a means of review. The students disagreed with the statement that AgXactly did not help in reviewing class concepts (mean = 1.89). Students agreed with the statement that if available, I would use AgXactly to study for tests (mean = 4.00). Students expressed the belief that computers are important to their future (mean = 4.34) and disagreed that they would not be comfortable working with new

technology (mean = 1.95). The mean response for each question can be found in Table 8. Frequency distributions for each question can be found in Appendix D. A copy of the AgXactly perception survey can be found in Appendix B.

Table 8. Mean Responses to the AgXactly Perception Survey.

Questions (Abbreviated)	Mean*	Std. Deviation
I found this computer review tool easy to use	4.09	.884
This program motivated me to learn	3.59	.658
I prefer quiz game review to traditional class	3.39	1.146
The computer program was dull and uninteresting	1.93	.998
AgXactly would save me time when studying	3.75	1.164
I would learn more from using a quiz game	3.89	.868
AgXactly was not an effective review method	1.95	.987
I would not prefer to review from a quiz game	2.30	1.231
I would prefer to review from a quiz game	3.48	1.131
I do not like to use computers	2.02	1.210
The image questions were not helpful	2.34	.914
AgXactly did not help in reviewing class concepts	1.89	.841
I enjoy learning about this material	4.30	.734
I believe AgXactly would be a good supplemental study tool	4.20	.632
Other subjects could be taught using AgXactly	3.98	.849
AgXactly helped me to visualize concepts presented	3.59	1.041
AgXactly was not an effective way to review these concepts	1.86	.852
If available, I would use AgXactly to study for tests	4.00	1.012
Computers are important to my future	4.34	.713
The image questions helped me visualize the concepts shown	3.09	1.137
I Do not feel confident working with technology	1.95	1.011
Quiz games are more exciting than classroom activities	3.48	.952
AgXactly questions were easy to comprehend	3.91	.960
More computer quiz review tools are needed	3.77	.859

*Scale Used 5 = Strongly Agree, 3 = Neutral, 1 = Strongly Disagree

Comparison of Demographics and Academic Achievement

Further examination of the data considered a possible relationship between demographics and academic achievement. The demographic variables considered were gender, 4-H and FFA involvement, computer ownership, size of high school, and age. Gender, 4-H and FFA involvement, and computer ownership were analyzed using independent sample t tests. No significant differences at the .05 level of significance were found. Concerning gender $t_{(38)} = -.462, p = .646$. Concerning 4-H involvement $t_{(38)} = 1.583, p = .122$. Analysis of FFA involvement revealed $t_{(38)} = .580, p = .565$. Analysis of computer ownership revealed $t_{(38)} = -.462, p = .646$. Tables 9, 10, 11, and 12 illustrate these findings.

Table 9. t-test for Gender vs. Academic Achievement.

t	Degrees of Freedom	Significance (2-tailed)	Mean Difference
-.462	38	.646	-.1869

Table 10. t-test for 4-H Involvement vs. Academic Achievement.

t	Degrees of Freedom	Significance (2-tailed)	Mean Difference
1.583	38	.122	.6212

Table 11. t-test for FFA involvement vs. Academic Achievement.

t	Degrees of Freedom	Significance (2-tailed)	Mean Difference
.580	38	.565	.2331

Table 12. t-test for Computer Ownership vs. Academic Achievement.

t	Degrees of Freedom	Significance (2-tailed)	Mean Difference
-.462	38	.646	-.1869

The relationship between size of high school and academic achievement as measured by the posttest was analyzed using a one-way ANOVA. The students were divided into four groups. These groups were 24-58, 59-300, 301-500, 501-1500. No significant difference was found between the four groups, $F_{(3)} = .533$, $p = .663$. These findings are illustrated in Table 13.

Table 13. School Size vs. Posttest Scores.

	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Between	2.788	3	.929	.533	.663
Within.	57.536	33	1.744		
Total	60.324	36			

The relationship between age and posttest performance was analyzed using a one-way ANOVA. No significant difference was found, $F_{(6)} = .701$, $p = .650$. These findings are illustrated in Table 14.

Table 14. Age vs. Posttest Scores.

	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Between	6.987	6	1.164	.701	.650
Within.	54.788	33	1.660		
Total	61.775	39			

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Games are increasingly being used in education. Many benefits such as increased student motivation, and decreased instructional time can be garnered from this practice. Games have been proven as an effective instructional tool. The purpose of this study was to determine if games were also effective as a means of review.

This study was conducted using a Solomon Four research design. The participants were students enrolled in Montana State University's Animal and Range Natural Resources 100, Introduction to Animal Science, course during Spring Semester 2003. The students were randomly assigned to one of four treatment groups. Traditional review pretest and posttest, Traditional review posttest only, Game review pretest and posttest, and Game review posttest only. The objectives of this study were:

1. To determine the affects of an interactive quiz game as a review tool on academic achievement as shown by scores on the posttest;

2 To determine the students' perception of the effectiveness of an interactive quiz game as a review tool as compared to traditional individual review;

3 To determine the relationship between demographic variables in the AgXactly review group and their posttest performance.

Data were collected using a pretest, posttest, and perceptions survey. The pretest and posttest were designed by the researcher and reviewed by Dr. Raymond Ansotegui the professor of ARNR 100. The perceptions survey possessed a Cronbach's alpha reliability coefficient of .9093. The pretest possessed a split half reliability coefficient of .4831. The posttest possessed a split half reliability coefficient of .2663.

The findings can be summarized in the following statements.

1. The student population was 55% female and 45% male.

2. The majority 77% (n=62) of the students were enrolled in MSU's College of Agriculture with Animal Science 29% (n=23), Agricultural Business 14% (n=11) and Agricultural Education 14% (n=11) being the most prevalent majors.

3. A 2 x 2 factorial analysis of variance was used to analyze differences between the four treatment groups in regards to their performance on the posttest. No significant difference was found.

4. The perceptions survey was analyzed using descriptive statistics.

5. The AgXactly treatment group was analyzed to determine any differences in regard to demographics and posttest performance. Demographic information considered was age, gender, 4-H and FFA involvement, computer ownership, and size of high school. No significant differences were found between demographic variables and posttest performance.

Conclusions

This study determined the effectiveness of traditional review versus review via a game. Student perceptions of the use of games in education were also determined.

Based upon the findings, the following statements are presented as conclusions:

1. The effectiveness of traditional review and review via a game was determined to be statistically equal.

2. Students in the AgXactly treatment group perceived games as a more desirable means of review than traditional review as evidenced by survey results.

3. Hypothesis 1: The use of AgXactly, an interactive quiz game, as a review tool will have no statistically significant affect on knowledge retention levels in the short term, must be accepted.

4. Hypothesis 2: Students' perceptions of the effectiveness of AgXactly, an interactive quiz game, as a review tool will not vary significantly from their

perceptions of traditional review, must be accepted because data regarding student perceptions of the effectiveness of AgXactly as a review tool was not collected for half of the study population.

Implications

The data and survey results provided by this study allowed the researcher to make the following statements:

1. The use of games as a review method can be equally effective as traditional review.
2. AgXactly is an appropriate review tool for post-secondary education.
3. AgXactly is appropriate for multiple disciplines.

Recommendations

The findings of this investigation revealed the effectiveness of games as a means of review as well as student perceptions towards the use of games as review. Based on these findings the following recommendations were made.

1. Games should be used as a means of review. Test scores were not increased by using games, but student motivation was (Amory et. al, 1999; Nemerow, 1996; Randel and Morris, 1992).
2. Future studies should consider the relationship between learning styles and review games.
3. Future studies should consider the incorporation of the Internet and online communication into review games.
4. Future studies should consider the use of review games at the primary and secondary education level.
5. Further research is needed to examine the use of games for instruction.

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APPENDICES

APPENDIX A

AGXACTLY DEMAND KNOWLEDGE TESTS

AgXactly Research Pretest

_____
Student ID Number

Please circle the most correct answer

1. Sheep are seasonal breeders.

a. True b. False

2. Equus Caballus refers to :

a. horses b. donkeys c. mules d. jackasses

3. _____ must reproduce inside a living host cell.

a. virus b. bacteria c. protozoa d. nits

4. A 16 hand horse weighing 1200 pounds would be classified as _____.

a. light b. heavy c. draft d. fat

5. Ovulation in the cow occurs _____.

a. at the onset of estrus b. 7 days post calving
c. 30 hours after beginning of estrus d. 2-3 days before ending of estrus

6. The progeny of a jackass and a mare would be a _____.

a. hinny b. horse c. donkey d. mule

7. Most range sheep have a strong flocking instinct. These instincts are stronger in ____.

a. fine wool breeds b. mutton breeds c. it doesn't matter, sheep are sheep

8. Horses have four mammary glands and ____ teats.

a. 2 b. 4 c. 6 d. 3

9. The primary use for horses in the United States is ____.

a. Work b. Sports c. Recreation d. Dogfood

10. The gestation length for a cow is on average ____ days.

a. 114 b. 336 c. 285 d. 420

AgXactly Research Posttest

_____
Student ID Number

Please circle the most correct answer

1. The gestation length for a sheep is on average ____ days.

a. 285 b. 147 c. 420 d. 336

2. Cattle have a ___ day estrous cycle.

a. 7 b. 28 c. 21 d. 18

3. ____ would be an example of a zoonoses, that is a disease which affects both animals and humans.

a. Foot and Mouth Disease b. Bluetongue c. Mastitis d. Brucellosis

4. "Foal heat" occurs in horses ___ days following parturition.

a. 1-5 b. 5-10 c. 10-15 d. 21

5. ____ refers to the process of increased feeding of the female prior to breeding.

a. Fattening up b. Flushing c. Crutching d. Top off

6. The progeny of a stallion and a jenny would be refered to as a _____.

a. hinny b. mule c. horse d. donkey

7. Cows are seasonal breeders.

a. true b. false

8. Ovulation in the mare occurs _____.
a. at the onset of estrus b. 24-36 hours before the end of estrus
b. 24-36 hours post estrus d. 12 hours post breeding

9. Over 50% of calves come from operations consisting of _____ cows.

a. 100-250 b. 250-500 c. 1-50 d. 50-100

10. Horses are seasonal breeders with estrus activity tied to ____ periods of daylight.
a. Decreasing b. Increasing c. Equal

APPENDIX B

AGXACTLY PRECEPTIONS SURVEY

Montana State University – Bozeman

AgXactly™ Perceptions and Demographics Questionnaire

Student ID#_____

Date: _____

The following questions ask you to evaluate the AgXactly program as presenting the principles discussed in class. Answer the questions to the best of your ability. Please remember that there are no right or wrong answers. Use the scale below to answer the following questions.

Strongly Agree		**Neutral**		**Strongly Disagree**
5		**3**		**1**
1.	I found this computer review tool easy to use.	5	4 3 2	1
2.	This program motivated me to learn.	5	4 3 2	1
3.	I would prefer to review from a computer quiz game than a traditional class.	5	4 3 2	1
4.	I believe that the computer program was dull and uninteresting.	5	4 3 2	1
5.	The computer quiz game would save me time when studying for the next test.	5	4 3 2	1
6.	I believe that I would learn more in review of my courses if quiz programs such as this one were available for my use.	5	4 3 2	1
7.	I believe that this program was not an effective method of review.	5	4 3 2	1
8.	If given the choice, I would not want to review from this type of program.	5	4 3 2	1
9.	I would prefer to review from a computer than from a textbook/class notes.	5	4 3 2	1
10.	I do not like to use computers.	5	4 3 2	1
11.	The image questions did not help me review the concepts and definitions presented.	5	4 3 2	1
12.	The computer quiz game did not increase my understanding of the concepts for review.	5	4 3 2	1
13.	I enjoy learning about this material.	5	4 3 2	1
14.	I believe that this program would be an excellent supplemental study tool.	5	4 3 2	1
15.	Other agricultural subjects I have studied could be taught using this type of computer presentation mode.	5	4 3 2	1
16.	The computer quiz game helped me visualize the concepts presented.	5	4 3 2	1
17.	The computer program was not an effective way to review these concepts.	5	4 3 2	1
18.	If available, I would use a program like this to study for tests.	5	4 3 2	1
19.	Computers are important to my future.	5	4 3 2	1
20.	The image questions helped me visualize the concepts that were presented.	5	4 3 2	1
21.	I do not feel confident in my abilities to work with technology.	5	4 3 2	1
22.	Computer quiz games are more exciting than classroom activities.	5	4 3 2	1
23.	The questions on the quiz game were easy to comprehend.	5	4 3 2	1
24.	More computer quiz review tools are needed for students to use.	5	4 3 2	1

Please provide any additional comments you may have about the computer quiz game for review of classroom concepts.

Demographic Information

Gender: Male ___ Female ___

Age/Grade: ___ yrs/ ____

Plans to continue education: Yes___ No___

FFA Involvement: _____

4-H Involvement: _____

Where did you grow up? Urban ___ Rural ___

Size of city, if urban: _____

Size of school, if rural: _____

Have you ever participated in this type of activity before? Yes ___ No ___

Rate the quality of your past experiences with computer instruction. Please check appropriate boxes.

	V. Good –5-	-4-	Neutral –3-	-2-	V. Poor –1-
Md. School					
Hi. School					
College					

Indicate computer ownership and use. Please check all that apply.

___ Own a computer currently.

___ Rent a computer currently.

___ Plan to own a computer soon.

___ Use school facilities.

___ Use roommate/family/friend(s) computer.

___ No plans to own a computer.

Thank you for taking the time to complete this questionnaire.

APPENDIX C

FREQUENCY TABLES RATING PRIOR USE OF COMPUTERS IN EDUCATION

Table C1. Frequency of Responses Rating Prior Use of Computers in Education: Middle School.

		Frequency	Percent	Valid Percent
Valid	0	4	8.9	9.5
	1	4	8.9	9.5
	2	5	11.1	11.9
	3	16	35.6	38.1
	4	5	11.1	11.9
	5	8	17.8	19.0
	Missing	3	6.7	

Table C2. Frequency of Responses Rating Prior Use of Computers in Education: High School.

		Frequency	Percent	Valid Percent
Valid	0	4	8.9	9.5
	1	1	2.2	2.4
	2	4	8.9	9.5
	3	6	13.3	14.3
	4	14	31.1	33.3
	5	13	28.9	31.0
	Missing	3	6.7	

Table C3. Frequency of Responses Rating Prior Use of Computers in Education: College.

		Frequency	Percent	Valid Percent
Valid	0	4	8.9	9.5
	1	1	2.2	2.4
	2	0	0	0
	3	8	17.8	19.0
	4	13	28.9	31.0
	5	16	35.6	38.1
	Missing	3	6.7	

APPENDIX D

FREQUENCY TABLES LISTING STUDENT RESPONSES TO PRECEPTION SURVEY QUESTIONS

Table D1. Frequency Distribution of Responses to Question 1 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	0	0	0	0
2	3	6.7	6.8	6.8
3	6	13.3	13.6	20.5
4	19	42.2	43.2	63.6
5	16	35.6	36.4	100.0
Missing	1	2.2		

Table D2. Frequency Distribution of Responses to Question 2 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	0	0	0	0
2	1	2.2	2.3	2.3
3	19	42.2	43.2	45.5
4	21	46.7	47.7	93.2
5	3	6.7	6.8	100.0
Missing	1	2.2		

Table D3. Frequency Distribution of Responses to Question 3 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	2	4.4	4.5	4.5
2	8	17.8	18.2	22.7
3	14	31.1	31.8	54.5
4	11	24.4	25.0	79.5
5	9	20.0	20.5	100.0
Missing	1	2.2		

Table D4. Frequency Distribution of Responses to Question 4 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	15	33.3	34.1	34.1
2	18	40.0	40.9	75.3
3	7	15.6	15.9	91.0
4	2	4.4	4.5	95.4
5	1	2.2	2.3	100.0
Missing	1	2.2		

Table D5. Frequency Distribution of Responses to Question 5 of the AgXactly Perception Survey.

	Frequency	Percent	Valid Percent	Cumulative Percent
1	3	6.7	6.8	6.8
2	4	8.9	9.1	15.9
3	6	13.3	13.6	29.5
4	19	42.2	43.2	72.7
5	12	26.7	27.3	100.0
Missing	1	2.2		

Table D6. Frequency Distribution of Responses to Question 6 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
2	2	4.4	4.5	4.5
3	13	28.9	29.5	34.1
4	17	37.8	38.6	72.7
5	12	26.7	27.3	100.0
Missing	1	2.2		

Table D7. Frequency Distribution of Responses to Question 7 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	17	37.8	38.6	38.6
2	16	35.6	36.4	75.0
3	8	17.8	18.2	93.2
4	2	4.4	4.5	97.7
5	1	2.2	2.3	100.0
Missing	1	2.2		

Table D8. Frequency Distribution of Responses to Question 8 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	15	33.3	34.1	34.1
2	12	26.7	27.3	61.4
3	8	17.8	18.2	79.5
4	7	15.6	15.9	95.5
5	2	4.4	4.5	100.0
Missing	1	2.2		

Table D9. Frequency Distribution of Responses to Question 9 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	2	4.4	4.5	4.5
2	7	15.6	15.9	20.5
3	12	26.7	27.3	47.7
4	14	31.1	31.8	79.5
5	9	20.0	20.5	100.0
Missing	1	2.2		

Table D10. Frequency Distribution of Responses to Question 10 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	21	46.7	47.7	47.7
2	9	20.0	20.5	68.2
3	8	17.8	18.2	86.4
4	4	8.9	9.1	95.5
5	2	4.4	4.5	100.0
Missing	1	2.2		

Table D11: Frequency Distribution of Responses to Question 11 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	9	20.0	20.5	20.5
2	9	20.0	20.5	41.0
3	24	53.3	54.5	94.5
4	1	2.2	2.3	100.0
5	0	0		
Missing	1	22.2		

Table D12. Frequency Distribution of Responses to Question 12 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	14	31.1	31.8	31.8
2	19	42.2	43.2	75.0
3	9	20.0	20.5	95.5
4	1	2.2	2.3	100.0
5	0	0		
Missing	1	2.2		

Table D13. Frequency Distribution of Responses to Question 13 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	0	0	0	0
2	0	0	0	0
3	7	15.6	15.9	15.9
4	17	37.8	38.6	54.5
5	20	44.4	45.5	100.0
Missing	1	2.2		

Table D14. Frequency Distribution of Responses to Question 14 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	0	0		
2	0	0		
3	5	11.1	11.4	11.4
4	25	55.6	56.8	68.2
5	14	31.1	31.8	100.0
Missing	1	2.2		

Table D15. Frequency Distribution of Responses to Question 15 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	0	0		
2	2	4.4	4.5	4.5
3	10	22.2	22.7	27.3
4	19	42.2	43.2	70.5
5	13	28.9	29.5	100.0
Missing	1	2.2		

Table D16. Frequency Distribution of Responses to Question 16 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	2	4.4	4.5	4.5
2	4	8.9	9.1	13.6
3	12	26.7	27.3	40.9
4	18	40.0	40.9	81.8
5	8	17.8	18.2	100.0
Missing	1	2.2		

Table D17. Frequency Distribution of Responses to Question 17 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	17	17	38.6	38.6
2	18	18	40.9	79.5
3	7	7	15.9	95.5
4	2	2	4.5	100.0
5	0	0		
Missing	1	1		

Table D18. Frequency Distribution of Responses to Question 18 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	1	2.2	2.3	2.3
2	3	6.7	6.8	9.1
3	7	15.6	15.9	25.0
4	17	37.8	38.6	63.6
5	16	35.6	36.4	100.0
Missing	1	2.2		

Table D19. Frequency Distribution of Responses to Question 19 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	0	0		
2	0	0		
3	6	13.3	13.6	13.6
4	17	37.8	38.6	52.3
5	21	46.7	47.7	100.0
Missing	1	2.2		

Table D20. Frequency Distribution of Responses to Question 20 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	2	4.4	4.8	4.8
2	3	6.7	7.1	11.9
3	25	55.6	59.5	71.4
4	7	15.6	16.7	88.1
5	5	11.1	11.9	100.0
Missing	3	6.7		

Table D21. Frequency Distribution of Responses to Question 21 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	15	33.3	34.9	34.9
2	17	37.8	39.5	74.4
3	8	17.8	18.6	93.0
4	2	4.4	4.7	97.7
5	1	2.2	2.3	100.0
Missing	2	4.4		

Table D22. Frequency Distribution of Responses to Question 22 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	3	6.7	6.8	6.8
2	1	2.2	2.3	9.1
3	16	35.6	36.4	45.5
4	20	44.4	45.5	90.9
5	4	8.9	9.1	100.0
Missing	1	2.2		

Table D23. Frequency Distribution of Responses to Question 23 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	1	2.2	2.3	2.3
2	3	6.7	6.8	9.1
3	7	15.6	15.9	25.0
4	21	46.7	47.7	72.7
5	12	26.7	27.3	100.0
Missing	1	2.2		

Table D24. Frequency Distribution of Responses to Question 24 of the AgXactly Perception Survey.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	1	2.2	2.3	2.3
2	1	2.2	2.3	4.6
3	13	28.9	29.5	34.1
4	21	46.7	47.7	81.8
5	8	17.8	18.2	100.0
Missing	1	2.2		

APPENDIX E

CURRICULUM VITAE OF DR. RAYMOND ANSOTEGUI

Raymond P. Ansotegui

Associate Professor
Department of Animal and Range Sciences
Montana State University

PERSONAL INFORMATION

Office Address:	235 Linfield Hall Animal and Range Sciences Montana State University Bozeman, MT 59717
Home Address:	124 Paradise Drive Livingston, MT 59047
Marital Status:	Wife: Linda Daughter: Denise Son: Raymond

PRESENT POSITION APPOINTMENT

Associate Professor	Animal and Range Sciences (70% Teaching; 30% Research)

EDUCATION

BS 1970	University of Nevada-Reno	Animal Science
MS 1973	University of Nevada-Reno	Range Nutrition
Ph.D. 1986	New Mexico State University	Ruminant Nutrition

PROFESSIONAL EXPERIENCE

1994-Present	Associate Professor Animal & Range Sciences	Montana State University

1995	Sabbatical Leave	
	Faculty of Agriculture	University Western Australia
1976-1994	Instructor/Assistant Professor	
	Animal & Range Sciences	Montana State University
1973-1976	District Sales Manager	American Breeders Service

PROFESSIONAL AND HONORARY SOCIETIES

American Society of Animal Science
Gamma Sigma Delta
Phi Kappa Phi

AWARDS AND RECOGNITIONS

2002 James and Mary Ross Provost's Award for Excellence in Teaching and Scholarly Activity
2002 Western Section American Society of Animal Science Distinguished Teacher Aware
1999 Award for Excellence
1996 Award for Excellence
1996 Mortar Board Professor of the month
1992 Mortar Board Exemplary Performance as an Educator
1991 Alpha Zeta Professor of the Year
1990 Outstanding Teacher - College of Agriculture
1990 Faculty Honor Roll for Outstanding Student Instruction
1988 Faculty Honor Roll for Outstanding Student Instruction
1985 Outstanding Teacher - College of Agriculture
1985 Faculty Honor Roll for Outstanding Student Instruction
1981 Faculty Honor Roll for Outstanding Student Instruction
1980 Faculty Honor Roll for Outstanding Student Instruction

TEACHING RESPONSIBILITIES

Recent Courses	Title	Credits	Enrollment
ARNR 100	Introduction to Animal Science	3	190
ARNR 105	Introduction to Animal Science Lab	1(6)	120
ARNR 234	Beef Cattle Practicum	1	20
ARNR 320	Integrated Nutrition Management I	3	70
ARNR 324	Integrated Nutrition Management II	3	60

ARNR 330	Range Livestock Production	4	80
ARNR 421	A I and Physiology of Gestation	4	35
ARNR 435	Feedlot Management	3	25
ARNR 436	Range Animal Interactions	3	35
ARNR 470	Individual Problems	1-3	7-8/yr
ARNR 476	Internship	3-12	3-4/yr
ARNR 480	Calving Management	2	25
ARNR 489	Undergraduate Research		3-4/yr

All Courses taught at MSU	Title
ANS101	Animal Science in Agriculture
ANS101	Animal Science in Agriculture
ANS120	Artificial Insemination
ANS130	Basic Equitation
ANS131	Intermediate Equitation
ANS210	Livestock Evaluation I
ANS211	Livestock Evaluation II
ANS222	Feeds and Feeding
ARNR234	Beef Cattle Practicum
ANS300	Seminar
ANS308	Competitive Livestock Evaluation
ANS309	Animal Nutrition
ANS310	Animal Nutrition II
ANS320	Integrated Nutrition Management I
ARNR324	Integrated Nutrition Management II
ANS327	Beef Production
ANS328	Beef Production Lab
ARNR330	Range Livestock Production
ANS400	Senior Seminar
RAS410	Range Nutrition
ANS411	Physiology of Gestation Lab
ANS418	Commercial Feeds and Feeding
ARNR421	Artificial Insemination and Physiology of Gestation
ANS427	Beef Cattle Management
ARNR435	Feed Lot Management
ARNR436	Range Animal Interactions
ANS470	Individual Studies
ANS476	Internship
ARNR480	Calving Management
ARNR489	Undergraduate Research
RAS503	Range Livestock Nutrition
ANS570	Individual Studies

ANS590 Masters Thesis

Advising

Average number of undergraduate advisees, 20-25/yr
Graduate Student Committees, 4-5/yr

RESEARCH EMPHASIS

Cow/calf Nutrition, Range Forage Utilization, Estrous Synchronization, Trace Mineral Nutrition

MOST SIGNIFICANT RESEARCH AND TEACHING ACCOMPLISHMENTS

Quantification of range forage intake by suckling calves.
Demonstrated changes in forage intake of suckling calves relative to milk intake.
Determined ruminal kinetics and forage utilization by suckling calves grazing native range.
Demonstrated that combinations of progestins and prostaglandins can be used to successfully synchronize estrus in beef heifers and cows.
Effects of form and intake of trace minerals on immune function in beef heifers.
Effects of antagonistic minerals on Cu and Zn status
Demonstrated the inaccuracy of using serum as a measure of mineral status
Taught 30 different classes at MSU
Received 12 teaching awards

EXTRAMURAL FUNDING

2002	Trace minerals for beef cattle ZinPro, Inc	$25,000
2001	Dystocia of Angus and Simmental American Simmental	$15,000
2001	Trace Mineral Bioavailability with David Wichman and Dennis Cash -Fertilizer Check Off	$ 8,000
2000	Dystocia of Angus and Simmental American Simmental	$15,000
1999	Dystocia of Angus and Simmental American Simmental	$15,000
1998	Trace minerals for beef cattle ZinPro, Inc	$66,000
1996	Trace minerals for beef cattle ZinPro, Inc	$75,000
1995	Trace minerals for beef cattle	$12,000

	ZinPro, Inc	
1994	Trace minerals for beef cattle	$25,000
	ZinPro, Inc	
1994	Trace minerals for beef cattle	$12,000
	ZinPro, Inc	
1992	Effects of cubing hay on yearling beef heifers	$16,500
	High Mountain Ranches	
1992	Effects of Cubing Hay on Two-year-old Beef Heifers	$8,500
	High Mountain Ranches	
1992	Rumen kinetics of different protein sources	$1,000
	Specialty Vegetable Oils	
1990	Alteration of Sex Rations	$25,000
	Big Sky Genetics	
Yearly	Vaccine Grants	$4,000
	Grand Laboratories	
Yearly	Semen Grants	$3,000
	Producer and Industry	

Teaching Grants:

2002 – National Cattlemen's Beef Association - $3,000
2001 – National Cattlemen's Beef Association - $3,000

These grants were received to attend the NCBA Beef Instructors Update School held in Kansas City, Missouri during 2001 and 2002. The purpose of the Update School is to present the latest pedagogy and information transfer methodology available to educators in Beef Cattle Science.

1977-2002 – American Breeders Service; Select Sires, Inc. - $100,000 ($4,000/year)

This continuing grant is specifically targeted to support the education of undergraduate students in Reproductive Technologies (ARNR 421 – Assisted Reproductive Technologies). These moneys have been used to purchase teaching equipment such as liquid nitrogen tanks, AI sleeves, semen, and other associated equipment. Even though students pay a lab fee to take this class, it would be impossible to offer the advanced level of experience that is provided to students without this continuing grant support.

1977-2002 – American Breeders Service; Select Sires, Inc. - $25,000

This livestock revolving account was initially started with a grant from American Breeders Service and Select Sires, Inc. The money is used to purchase cows that are exclusively used for teaching ARNR 421. This

affords our students the opportunity to have an exclusive herd of cows used for hands-on education in Reproductive Technologies. Because of this grant, each student in ARNR 421 has the opportunity to practice artificial insemination and pregnancy diagnosis on cows of differing reproductive status.

2000-2003 – American Simmental Association - $8,000 ($2,000/year)

This grant supports the teaching of ARNR 215 – Calving Management. These moneys are used for meals, lodging and travel for 20 students/year to participate in a hands-on research project evaluating the effect of sire and breed on dystocia. Students collect data and actually participate in calving approximately 500 heifers on 3 separate ranches.

RESEARCH AND TEACHING GOALS AND DIRECTION FOR NEXT FIVE YEARS

Effects of micro nutrients on performance and the immune system of beef cattle.
Range forage utilization of cattle with different production potentials.
Nutritional factors effecting heifer performance and puberty.

PUBLICATIONS

REFEREED PUBLICATIONS

Funston, R.N., T.W. Geary, R.P. Ansotegui, R.J. Lipsey, and J.A. Paterson. 2002. Supplementation with whole sunflower seeds before artificial insemination in beef heifers. Prof. Anim. Sci. 18:254-257.

Swenson, C.K., R. P. Ansotegui, J. A. Paterson, E. J. Swensson. 2002. Effects of trace mineral supplementation on cellular immunity and blood profiles of first-calf beef heifers and their calves. J. Anim. Sci. (submitted, in review).

Paterson, J.A., C.K. Swenson, A.B. Johnson, and R.P. Ansotegui. 2002. Copper and zinc needs for reducing stress in beef production. Anim. Feed Sci. Tech. (accepted).

Funston, R.N., R.P. Ansotegui, R.J. Lipsey and T.G. Geary. 2002. Comparison of the melengesteral acetate (MGA/PGF) and Select Synch preceded by seven day MGA estrous synchronization protocols in beef heifers. Theriogenology 57:1485-1491.

Bailey, J.D., R.P. Ansotegui, J.A. Paterson, C.K. Swenson, and A.B. Johnson. 2001. Effects of supplementing combinations of inorganic and complexed copper and zinc on performance and liver mineral status of heifers. J. Anim. Sci. J. Anim. Sci. 79: 2926-2934.

Voyich, J.M., R.P. Ansotegui, C.K. Swenson, J.D. Bailey, and D.E. Burgess. (2001) Antibody responses of cattle immunized with the Tf190 adhesion of *Tritrichomonas foetus*. Clinical and Diagnostic Lab. Immun. 8:1120-1125.

Hatfield, P.G., C.K. Swenson, R.W. Kott, R.P. Ansotegui, N.J. Roth, and B.L. Robinson. 2001. Zinc and copper status in ewes supplemented with sulfate- and amino acid-complexed forms of zinc and copper. J. Anim. Sci. 79: 261.

Anderson, L.P., J.A. Paterson, R.P. Ansotegui, M. Cecava and W. Schmutz. 2001. The effects of degradable and undegradable intake protein on the performance of lactating first-calf heifers. J. Anim. Sci. 79:2224-2232.

Ansotegui, R.P., E.J. Swensson, M.W. Tess, K.S. Bryan, C.K. Clark, and R.M. Brownson. 1995. Effects of cubing alfalfa hay on development of yearling beef heifers and In Situ rate and extent of disappearance. Prof. Anim. Sci. 11:30.

Sprinkle, J.E., D.D. Kress, D.E. Doornbos, D.C. Anderson, M.W. Tess, R.P. Ansotegui, B.E. Olson, and N.J. Roth. 1995. Chromic oxide contamination of forage in pasture previously used in marker studies. J. Range Manage. 48:194.

Lalman, D.L., M.K. Petersen, R.P. Ansotegui, M.W. Tess, C.K. Clark and J.S. Wiley. 1993. The effects of ruminally undegradable protein, propionic acid and monensin on puberty and pregnancy in beef heifers. J. Anim. Sci. 71:2843.

Dhuyvetter, D.V., M.K. Petersen, R.P. Ansotegui, R.A. Bellows, B. Nisley, R. Brownson and M.W. Tess. 1993. Reproductive efficiency of range beef cows fed differing quantities of ruminally undegradable protein prior to breeding. J. Anim. Sci. 71:2586.

Ansotegui, R.P., K.M. Havstad, J.D. Wallace and D.M. Hallford. 1991. Effects of milk intake on forage intake and performance of suckling range calves. J. Anim. Sci. 69:899.

Frey, A.L., V.M. Thomas, R.P. Ansotegui, P.J. Burfening and R.W. Kott. 1991. Influence of escape protein supplementation to grazing ewes on milk production and lamb performance. Small Ruminant Research.

Wiley, J.S., M.K. Petersen, R.P. Ansotegui and R.A. Bellows. 1991. Production from first-calf beef heifers fed a maintenance or low level of prepartum nutrition and ruminal undegradable or degradable protein post partum. J. Anim. Sci. 69:4279.

Wiley, J.S., M.K. Petersen, C.K. Clark, R.P. Ansotegui and D.W. Lodman. 1991. The influence of timing and the addition of urea to supplements containing dl-methionine on ruminal fermentation and cow weight change in beef cows. J. Anim. Sci. 69:4617.

Roberson, M.S., R.P. Ansotegui, J.G. Berardinelli, R.W. Whitman and M.J. McInerney. 1987. Influence of biostimulation by mature bulls on occurrence of puberty in beef heifers. J. Anim. Sci. 64:1601.

Higgins, C.K., J.G. Berardinelli, D.K. Han, R.P. Ansotegui and E.L. Moody. 1986. Estrus synchronization systems involving prostaglandin $F_{2\square}$ and progesterone pretreatment in beef heifers. Theriogenology 25:249.

REVIEWED PUBLICATIONS, ABSTRACTS AND PROCEEDINGS

Davis K.C., M.W. Tess, R.P. Ansotegui, and S. Yamamoto. 2002. Carcass characteristics of steers sired by high marbling EPD or high percent retail product EPD bulls. Proc. West. Sec. Amer. Soc. Anim. Sci 53.

Funston R.N., R.P. Ansotegui, R.J. Lipsey, and T.W. Geary. 2002. Evaluation of melengestrol acetate/prostaglandin (MGA/PGF), Select Synch, and 7d MGA/Select Sync estrous synchronization protocols in beef heifers. Proc. West. Sec. Amer. Soc. Anim. Sci 53.

Funston, R.N., T.W. Geary, R.P. Ansotegui, J.J. Lipsey, M.D. MacNeil, and J.A. Paterson. (2001) Supplementation of whole sunflower seeds before AI in beef heifers. Proc. West. Sec. Amer. Soc. Anim. Sci 52:381-383.

Kress, D.D., D.C. Anderson, J.D. Stevens, E.T. Miller, T.S. Hirsch, J.E. Sprinkle, K.C. Davis, D.L. Boss, D.W. Bailey, R.P. Ansotegui, and M.W. Tess (2001) Calf weight/cow weight ratio at weaning as a predictor of beef cow efficiency. Proc. West. Sec. Amer. Soc. Anim. Sci 52:130-131.

Edwards, N.J., R.P. Ansotegui, E. Leadbetter, and N.D. Costa. 2000. Straw Supplementation of Cattle Browsing Tagasaste During Summer/Autumn Reduces Sand Accumulation in the Rumen. Proc. Aust. Soc. Anim. Sci. 23:75.

Bailey J.D., R.P. Ansotegui, J.A. Paterson, and C.K. Swenson. 2000. Feedlot performance and hepatic trace mineral status of beef heifers previously consuming dietary copper antagonists. Proc. West. Sec. Amer. Soc. Anim. Sci. 51:128.

Funston, R.N., R.P. Ansotegui, B.D. Thompson, R.J. Lipsey, M.D. Ropp and T.W. Geary. 2000. Evaluation of melengesterol acetate/prostaglandin (MGA/PGF) and MGA/Select Synch estrous synchronization protocols in beef heifers. Proc. West. Sec. Amer. Soc. Anim. Sci. 51:140.

Paterson, J.A., C. Swenson, B. Johnson and R. Ansotegui.2000. Life cycle trace mineral needs for reducing stress in beef production. Asociacion Mexicana de Especialistas en Nutricion Animal A.C., Guadalajara, MX (invited).

Swenson, C.K., R.P. Ansotegui, J.A. Paterson and B. W. Hess 2000. Trace Minerals Optimal Supplementation Strategies with Beef Cattle Consuming Low Quality Forages in the U.S. Agricultural Experiment Station Special Report. Oregon State University Printing.

Ansotegui, R.P., J.D. Bailey, J.A. Paterson, P.G. Hatfield, and C.K. Swenson. 1999. Effects of supplemental trace mineral form on copper status, estrus, ovulation rate, and fertility in beef heifers. Proc. West. Sec. Amer. Soc. Anim. Sci.

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Swenson, C.K., R.P. Ansotegui, E.J. Swensson, J.A. Paterson, and A.B. Johnson. 1998. Trace mineral supplementation effects on first-calf beef heifer reproduction, milk production and calf performance. Proc. West. Sec Amer. Soc. Anim. Sci. 49:327.

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GRADUATE STUDENT THESES AND DISSERTATIONS:

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Bailey, J.D. 1999. Influence of form of supplementary copper and zinc on mineral status and performance of beef heifers during and after mineral antagonism.

M.S. Animal Science, Montana State University. Bozeman.

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INVITED PRESENTATIONS AT REGIONAL, NATIONAL, AND INTERNATIONAL MEETINGS

Ansotegui, R.P. 2000. Winter supplementation strategies. Intertribal Agriculture Council Symposium. Las Vegas, NV.

Ansotegui, R.P. 2000. Body condition scoring and reproduction. Intertribal Agriculture Council Symposium. Las Vegas, NV.

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a.) Beef Boosters Annual conference. Red Deer, AB Canada. January 1998

b.) Alltech Feedlot Symposium. Calgary, AB. Canada. July 1998.

c.) Hubbard Milling Nutrition Symposium. Fairmont, MT. September 1998.

Paterson, J.A., B.K. Wellington, L. Anderson and R.P. Ansotegui. 1998. Supplementing western forages. Proc. Of Liquid Feed Symposium, Alburquerque, NM, Sept.

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a) IRM Producer Education Seminars- National Cattlemens Beef Association, Denver, CO, February 6th.

b) 1998 College Livestock Feed Conference Board Meeting, Ft. Mitchell, KY, Sept. 16th.

c) Zinpro Beef Seminar, Inverness, CO, July 29th.

d) Farmland Feed College, Kansas City, MO, Aug. 7th.

Swenson, C.K., R.P. Ansotegui and J.A. Paterson. 1996. Influence of mineral supplementation on mineral status, mineral retention and immune response in beef heifers and their calves. Proc. Liquid Feed Symposium. Omaha.

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Ansotegui, R.P. 1995. Careers in agriculture and resource management. Proc. Intertribal Ag. Council. Indian Agriculture past, present pathways to the future. Las Vegas, NV

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EXTENSION/PRODUCER PRESENTATIONS

8 to 10/yr, TOPIC AREAS: Beef Nutrition, Horse Nutrition, Reproductive Management of Beef Cattle. Last three years:

Bulls Verses AI.
Cattlemen's College- NILE, Billings, MT; October 2002.

Should I AI?
Producers Meeting, Deer Lodge, MT; October 2002.

EPD's, What Do They Mean?
Youth Judging Conference, Deer Lodge, MT; October 2002.

Managing Forage and Cattle for Best Returns.
Feed Dealers' Meeting, Billings, MT; September 2002.

Nutrition 101.
AI School Update, Billings, MT; April 2002.

Critical Periods in Trace Mineral Nutrition.
Livestock Producer Update, Livingston, MT; March 2002.

Nutrition 102.
Feed Dealers' Meeting, Red Lodge, MT; February 2002.

Environmental Factors Affecting Nutritional Requirements.
Billings, MT; February 2002.

Feeding the Backcountry Horse.

Outfitters School, Philipsburg, MT; May 2001.

Critical Periods in Trace Mineral Nutrition.
Area 1 Conservation District, Winnett, MT; September 2001.
Livestock Producer Update, Gillette, WY; February 2001.

Supplementation Alternatives.
Livestock Producer Update, Gillette, WY; February 2001.

AI & Estrous Synchronization.
Powell County Extension Producer Meeting, Hall, MT; February 2001.

Adaptation to Climatic Changes in Cattle.
Feed Dealer's Meeting, Red Lodge, MT; February 2001.

Pre-calving Nutrition.
Feed Dealer's Meeting, Red Lodge, MT; February 2001.
Musselshell Grazing Association, Roundup, MT; January 2001.

Feeding for Breeding.
Musselshell Grazing Association, Roundup, MT; January 2001.

Trace Mineral Availability.
Arizona State University, Tempe, AZ; October 2000.

Forage and Water Quality Problems in Saline Prone Areas.
Yellowstone Conservation District, Acton, MT; May 2000.

Back Country Horse Nutrition.
Outfitters School, Philipsburg, MT; May 2000.

Nutrition 101.
Feed Dealer's Meeting, Bozeman, MT; April 2000.

Feeding for Breeding.
AI Update Clinic, Bozeman, MT; January 2000 & Billings, MT; March 2000.

Calculating Intake.
Feed Dealer's Meeting, Red Lodge, MT; February 2000.

Animal Health Issues Relating to Trace Mineral Availability.
Stillwater Conservation District. Molt, MT; January 2000.

Evidence of Critical Periods for Trace Mineral Supplementation in Beef Cattle. Montana Veterinary Medical Association Winter Meeting, Bozeman, MT; January 2000.

CONSULTING

Highland Livestock, Livingston, MT
Sunlight Ranches, Powell, WY & Roundup, MT
Williams Livestock, Walden, CO
Dancing Wind Ranch, Livingston, MT
Dyer Livestock, Musselshell, MT
Mission Ranch, Livingston, MT
Royal Tine Outfitters, Phillipsburg, MT
Fayette Ranches, Pinedale, WY
Great Basin Agriculture, Elko, NV
Jefferson River Cattle Co., Twin Bridges, MT
King Ranch Inc., Kingsville, TX
Leachman Cattle Co., Billings, MT
Shelton Ranches, Gallatin Gateway, MT

SERVICE ACTIVITIES:

Department:
Promotion and Tenure Committee
Scholarship Committee
Montana Livestock Nutrition Conference Committee
Judging Activities Committee
Cattle Genetics Committee
Steer A Year Committee
Nutrition Center Lab Tech Position
(Committee Chairman)
Selection Committee for Beef Herdsman
Advisor Livestock Judging Club
Undergraduate Bulletin Committee
Selection Committee-Research Assistant Physiology
Nutrition Conference Committee
Selection Committee-Range Research Associate
Curriculum Committee
Horse Activities Committee
Farm Operations Committee
Coach Livestock Evaluation Teams
Advisor Animal Science Club

Additional Departmental Duties And Responsibilities:

Internship coordinator
Transfer and incoming Freshman Advisor
Twenty-five to thirty advisees per semester, I have my assigned advisees plus it appears I have all the minors.
Student employment following graduation
AQ
Ag in Montana Schools
Pregnancy testing of Departmental Cattle
Procurement of semen for departmental cattle
Twelve to fifteen 470 students per year
Undergraduate scholars projects
Cattle purchases for classes

Departmental Breeding Program:
In addition to my various departmental, college and university committees, I am also responsible for the breeding program for all of the departmental cattle. This includes the selection, ordering, and securing, of all of the semen to be used, as well as maintaining the storage and inventory this semen. I am also responsible for the artificial insemination and pregnancy checking of the departmental herds located on two separate facilities, as well as research cattle located on various producer ranches as part of a cooperative research project between the department and these producers. By the time you throw in my personal consulting activities, this adds up to breeding and pregnancy checking over 10,000 animals per year.

College:
Objectives Committee - Western Regional Project W-151
Scholarship Committee
Selection Committee
Extension Sheep Specialist
Ag Team Funding Committee

University:
Faculty Affairs
Sabbatical Leave Committee (Chairman 1992)
Phi Kappa Phi Selection Committee
for Outstanding Students

Other:

Western Section and American Society of Animal Science
Advisory and Coordinating Committee
Symposium Committee
Awards Committee
Planning Committee Grazing
Livestock Nutrition Conference
Montana Winter Fair, Board of Director

DISSERTATION AND THESES

Ansotegui, R P. 1986. Chemical composition and rumen digesta kinetics of diets selected and influence of milk intake by suckling calves grazing native range. Ph.D. Dissertation. New Mexico State Univ., Las Cruces.

Ansotegui, R.P. 1973. Composition of cattle and deer diets grazing in common. M.S. Thesis. University of Nevada, Reno.

APPENDIX F

TRADITIONAL REVIEW USED IN AGXACTLY RESEARCH

Table F1. Research Review – PowerPoint.

Disease and Adaptation

Adaptation

- Farm animals are homeothermic
  - I. E. Warm blooded
  - Maintain constant Body temp.
  - **Homeostasis** (constant body temp)

Reactions to Heat Stress

- Vasodilation
  - Dilation of blood vessels
- Sweating
- Panting
- Hormone and behavior changes

Reactions to cold stress

- Heat Conservation
  - Hair growth
  - vasoconstriction
  - lower respiratory rate
  - Seek shelter
  - Shiver

Reactions to cold stress

- Heat production
  - Increased Basal Metabolic Rate
  - Increased Activity
  - Increased Food Intake

Disease

- Parasites and Protozoa
  - Both internal and external
- Viruses
  - Must reproduce within living host cell
  - Many are host and tissue specific

Disease

- Bacteria
  - Single celled organisms cause damage via toxin production
- Protozoa
  - Single celled, larger than bacteria

Disease Immunity

- Inherited
  - Sickle cell anemia
- Acquired
  - Passive
    - Introduce antibodies
    - Colostrum
  - Active
    - Production of antibodies

Horse Production

Uses of Horses

- Recreation (primary usage)
- Sports
- Work
- Food
- Transportation
- Tax write off

Importance of horses

- Peak population in 1915 of 26 million
- Current population of 12 million
- $15 billion dollars of business generated annually

Equine Types

- Equus caballus
  - Horses
- Equus asinus
  - Donkey, Ass

Horse/Ass Crosses

- Jackass X Mare = Mule
- Stallion X Jenny = Hinny

Size Classifications

- Height measured in hands
  - 1 Hand = 4 inches
- Pony
  - Under 14.2 hands
  - Weigh 500-900 lbs

Size classifications

- Light Horse
  - 14.2 – 17 hands
  - 900-1400 lbs
- Draft Horse
  - 14.2-18 hands
  - 1400 + lbs

Horse Reproduction

- 21 day estrous cycle
- 1st estrus at 12-15 months
- 336 day gestation
- Seasonal breeders
  - Estrus activity tied to increasing daylength

Horse Reproduction

- 4-6 day heat
- Ovulation occurs 24-36 hours prior to end of estrus
- Foal heat
  - Estrus cycle usually occurs 5-10 days after foaling

•Sheep and Goat Production

Sheep Production

- Important ruminants in temperate and tropical regions
- Utilize different feedstuffs
  - Primarily short grasses and forbs
- Provide fiber, food, and hides

Consumption and Location in the US

- 1.6 lbs lamb annually
- 1 lb wool
- 80% in the West
- Majority of flocks 50 hd or less

Breeds of Sheep

- Ewe breeds
  - Usually white faced
  - Fine-medium or long wool
  - Bred for reproductive efficency, wool, and milk
  - Examples
    - Merino, Rambouillet, Targhee

Breeds of Sheep

- Ram Breeds
  - Meat type
  - Bred with emphasis on growth rate and carcass traits
  - Examples
    - Suffolk, Hampshire, Southdown

Breeds of Sheep

- Dual Purpose
  - Bred for both meat and wool production
  - Examples
    - Dorset, Columbia, Lincoln

Sheep Reproduction

- Seasonal Breeders
  - Estrus activity begins with decreased periods of light
- 147 day gestation
- Ewes are tagged or cruthed (wool is shorn around legs and rear) prior to lambing

Beef Production

Types of Operations

- Cow/Calf
- Stocker
- Feeder

Beef Reproduction

- 283 day gestation
- 21 day estrus cycle
- Calve in Fall or Spring depending on operation

Location and Composition of Herds

- 50% of herds are 50 head or less
- Feeder cattle concentrated in midwest
  - 1 Nebraska
  - 2 Texas
  - 3 Kansas

Lactation

Mammary Gland Function

- Provide nutrition to offspring
- Provide passive immunity to offspring

Mammary Gland Structure

- Exocrine gland- duct type
- Cow 4 glands 4 teats
- Mare 4 glands 2 teats
- Sow 6-20 glands 10-14 functional teats
- Sheep 2 glands 2 teats

Milk Production

- Regulated by hormones
- Production related to consumption
  - I.e. decreased consumption equals decreased production

APPENDIX G

AGXACTLY QUESTION DATABASE

Table G1. AgXactly Question Data Base.

Question #	Question Type	Category	Question Value
218	N	1	200
219	N	1	100
222	N	1	200
223	N	1	100
224	N	2	100
225	N	2	200
226	N	2	300
227	N	3	200
228	N	3	200
231	N	3	300
232	N	2	300
234	N	3	300
235	N	2	200
236	N	2	200
237	N	2	100
238	B	2	100
239	N	3	100
240	N	3	200
241	B	2	200
242	N	3	100
243	N	2	100
244	N	2	200
245	N	3	100
246	N	3	200
247	N	2	100
248	N	2	100
249	N	2	300
250	N	2	100
301	N	4	100
302	N	4	200
303	I	4	300
304	N	1	300
305	N	1	100
306	N	1	100
307	F	1	100
308	N	2	100
309	N	1	100
310	N	3	100
311	N	1	100
312	N	2	100
313	N	2	100
314	N	2	100
315	N	2	200
316	N	3	300
317	N	1	300

Table G2. AgXactly Questions.

Question #	Question
218	_____ are diseases which affect both animals and humans.
219	Which of the following is an inherited disease?
222	____ are used for the prevention of disease.
223	____ are primarily used for treatment of disease.
224	The lactation period for a dairy cow is ____ days.
225	The gestation period in horses is ___ days.
226	The gestation length in cattle is ____ days.
227	The gestation length in swine is ____ days.
228	The gestation length in sheep is ___ days.
231	Dystocia refers to problems encountered during ____.
232	True/False The dam of a hinny would be a mare.
234	___ would be an example of a dual-purpose breed of sheep.
235	A horse under 14 hands high would be classifed as a ____.
236	The primary use for horses in the United States is ____.
237	Horses are seasonal breeders with breeding activity tied to _____ levels of light.
238	Horses have a ____ day estrous cycle
239	True/False The average market weight for lambs is 110 lbs
240	Sheep are seasonal breeders with estrus activity tied to _____ levels of light.
241	The practice of providing extra feed to the female just prior to breeding is known as ____.
242	The majority of market lambs are sold and slaughtered in the ___.
243	___ is the leading state in marketing of feedlot cattle.
244	The % of animals affected or showing symptoms refers to ____.
245	True/False Bluetongue is a disease of concern to the sheep industry.
246	In most cases a ewe nursing twin lambs will give ___ milk than if she were nursing a single lamb.
247	True/False Over 50% of all calves come from herds of 50 cows or less.
248	_____ are the three types of Beef Cattle operations.
249	Annual cow costs for Montana are approximately $____/head/year.
250	Between the mule and the hinny which is the most fertile:
301	True/False Smurfs are three apples high.
302	_____ is the groundskeeper for the school on the cartoon show "The Simpsons".
303	The preceding image is what character from the cartoon hit "The Simpsons".
304	Farm animals are homeothermic, ie ____ blooded.
305	_____ refers to the maintenance of constant body temperature.
306	True/False Horses are primarily 'panters'.
307	Name the most important component of a succesful artificial insemination (AI) program.
308	Equus Caballus refers to ____.
309	A horse standing 16 hands high and weighing 1400 lbs would be classified as a ___ horse.
310	True/False Finns are examples of litter bearing sheep.
311	True/False Vasodilation is one means which animals may use to cope with cold stress.
312	Mares have 4 mammary glands and __ teats
313	Ovulation in horses occurs ___ hours prior to the end of estrus.
314	Ovulation in cows occurs __ hours after the onset of estrus.
315	___ regulates milk letdown
316	Sheep have a __ day estrous cycle.
317	___ must reproduce inside a living cell

Table G3. AgXactly Answers and Explanations - A.

Question #	Answer A	Explanation A
218	Zoonoses	Correct
219	Mastitis	Incorrect, but it will spread like wildfire through your herd.
222	Biologicals	Correct
223	Biologicals	Incorrect
224	105	Incorrect
225	285	Incorrect
226	336	Incorrect
227	114	Correct
228	285	Incorrect
231	Lactation	Incorrect
232	False	Correct.
234	Ramboullet	Incorrect.
235	Pony	Correct.
236	Work	Incorrect
237	Decreasing	Incorrect.
238	21	Correct. Horses cycle on a 21 day basis with heat lasting from 4 to 6 days. Ovulation occurs 24-36 hours prior to the end of estrus
239	True	Correct
240	Increasing	Incorrect.
241	Flushing	Correct.
242	Spring	Incorrect.
243	Nebraska	Correct
244	Mortality rate	Incorrect.
245	True	Correct.
246	More	Correct.
247	True	Correct
248	Feeder, stocker, cow/calf	Correct
249	200-250	Incorrect.
250	Mule	Incorrect.
301	True	Not Available.
302	Apu	Not Available.
303	Moe	Incorrect, Moe is the local tavern owner
304	Warm	Not Available.
305	Homeopathic	Not Available.
306	True	Incorrect
307	Heat Detection	Not Available.
308	Horses	Correct
309	Draft	Not Available.
310	True	Not Available.
311	True	Not Available.
312	2	Not Available.
313	12	Not Available.
314	12	Not Available.
315	Estrogen	Not Available.
316	21	Not Available.
317	Virus	Not Available.

Table G4. AgXactly Answers and Explanations - B.

Question #	Answer B	Explanation B
218	Pandemics	Incorrect
219	PSS	Correct. This is an inhertible disease in swine.
222	Pharmaceuticals	Incorrect
223	Pharmaceuticals	Correct
224	235	Incorrect
225	114	Incorrect
226	285	Correct
227	336	Incorrect.
228	114	Incorrect.
231	Weaning	Incorrect.
232	True	Incorrect.
234	Merion	Incorrect.
235	Dwarf	Incorrect.
236	Meat production	Incorrect
237	Equal levels of light and dark	Incorrect.
238	Not Available.	Not Available.
239	False	Incorrect.
240	Equal amounts of light and dark	Incorrect.
241	Unavailable	Incorrect.
242	Fall	Correct.
243	Kansas	Incorrect
244	Sick pen numbers	Incorrect.
245	False	Incorrect.
246	Less	Incorrect.
247	False	Incorrect.
248	Small, medium, large	Incorrect
249	250-300	Incorrect.
250	Hinny	Incorrect.
301	False	Not Available.
302	Moe	Not Available.
303	Apu	Incorrect, Apu manages the Kwik-E-Mart
304	Cold	Not Available.
305	Thermomaintenace	Not Available.
306	False	Correct
307	Not Available.	Not Available.
308	Donkeys	Not Available.
309	Light	Not Available.
310	False	Not Available.
311	False	Not Available.
312	4	Not Available.
313	48	Not Available.
314	24	Not Available.
315	Testosterone	Not Available.
316	17	Not Available.
317	Bacteria	Not Available.

Table G5. AgXactly Answers and Explanations - C.

Question #	Answer C	Explanation C
218	Somatics	Incorrect
219	Brisket disease	Incorrect
222	Unavailable	Unavailable
223	Unavailable	Unavailable
224	305	Correct
225	420	Incorrect
226	114	Incorrect
227	285	Incorrect.
228	147	Correct.
231	Parturition	Correct.
232	Unavailable.	Unavailable.
234	Dorset	Correct.
235	Midget	Incorrect.
236	Recreation	Correct
237	Horses are not seasonal breeders	Incorrect.
238	Not Available.	Not Available.
239	Unavailable	Incorrect.
240	Decreasing	Correct.
241	Unavailable	Incorrect.
242	Summer	Incorrect.
243	Texas	Incorrect
244	Morbidity rate	Correct.
245	Unavailable	Incorrect.
246	The same	Incorrect.
247	Unavailable	Incorrect.
248	Feedlot, Range production, mixed	Incorrect
249	300-350	Incorrect.
250	Both are sterile	Correct.
301	Not Available.	Not Available.
302	Willie	Not Available.
303	Barney	Correct, Barney is the town drunk
304	Not Available.	Not Available.
305	Homeostasis	Not Available.
306	Not Available.	Not Available.
307	Not Available.	Not Available.
308	Not Available.	Not Available.
309	Tall	Not Available.
310	Not Available.	Not Available.
311	Not Available.	Not Available.
312	6	Not Available.
313	24	Not Available.
314	48	Not Available.
315	Oxytocin	Not Available.
316	30	Not Available.
317	Nits	Not Available.

Table G6. AgXactly Answers and Explanations - D.

Question #	Answer D	Explanation D
218	Parablolas	Incorrect
219	Both A and C	Incorrect
222	Unavailable	Unavailable
223	Unavailable	Unavailable
224	270	Incorrect
225	336	Correct
226	147	Incorrect
227	150	Incorrect.
228	215	Incorrect.
231	Breeding	Incorrect.
232	Unavailable.	Unavailable.
234	Targhee	Incorrect.
235	A wee one	Incorrect.
236	Tax write-off	Incorrect
237	Increasing	Correct.
238	Not Available.	Not Available.
239	Unavailable	Incorrect.
240	Sheep are not seasonal breeders	Incorrect.
241	Unavailable	Incorrect.
242	Winter	Incorrect.
243	Rhode Island	Incorrect
244	Infective rate	Incorrect.
245	Unavailable	Incorrect.
246	Unavailable	Incorrect
247	Unavailable	Incorrect.
248	Eastern, Plains, Western	Incorrect
249	350-400	Correct.
250	Both are extremely fertile	Incorrect.
301	Not Available.	Not Available.
302	Ralph	Not Available.
303	Chief Wiggum	Incorrect, Wiggum manages, or mismangages, the Local police force
304	Not Available.	Not Available.
305	Temperostasis	Not Available.
306	Not Available.	Not Available.
307	Not Available.	Not Available.
308	Not Available.	Not Available.
309	Pony	Not Available.
310	Not Available.	Not Available.
311	Not Available.	Not Available.
312	8	Not Available.
313	2	Not Available.
314	30	Not Available.
315	Lutalyse	Not Available.
316	5	Not Available.
317	Protozoa	Not Available

Table G7. Correct Answers for AgXactly Data Base.

Question ID#	Correct Answer
218	a
219	b
222	a
223	b
224	c
225	d
226	b
227	a
228	c
231	c
232	a
234	c
235	a
236	c
237	d
238	a
239	a
240	c
241	a
242	b
243	a
244	c
245	a
246	a
247	a
248	a
249	d
250	c
301	a
302	c
303	c
304	a
305	a
306	b
307	a
308	a
309	a
310	a
311	b
312	a
313	c
314	d
315	c
316	b
317	a

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