Student Perceptions of an Introductory Animal Sciences Course for High-Ability Students[1]

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Abstract

As institutions recruit high-ability students through honors programs, greater offering of courses that satisfy program requirements at the departmental level are needed to meet the interest of students while promoting the desired outcomes of program involvement. The purpose of this study was to 1) describe, in detail, the development and implementation of an honors introductory animal sciences course; and 2) discuss the findings of the student evaluations of the course and course components. During its first offering autumn quarter 2009, students enrolled in Honors Introductory Animal Sciences were asked to complete a post-course questionnaire to assess student perceptions of the course. The course offered multiple teaching and learning methods. Lecture format was perceived most valuable by students, rating 4.85 ± 0.24 on a 5 point scale ($P < 0.05$). The scientific evaluation of the book *Portrait of a Burger as a Young Calf*, which required students to demonstrate reading comprehension and effective writing skills, received the lowest rating (3.85 ± 0.24) by students. Overall, students agreed that the course taught them a great deal about domesticated animal species (4.46 ± 0.24) and animal science disciplines (4.69 ± 0.24) and the enhanced learning experiences were recognized as valuable learning components.

Introduction

Honors programs have been established at many universities and colleges to attract academically high-ability students. In turn, the post-graduate success of students originating from these programs reflects the quality and effectiveness of the undergraduate curriculum of the institution (Seifert et al., 2007). Students within honors programs are academically superior and honors programs aim to enhance the undergraduate education for these academically talented students (Kaczvinsky, 2007). Seifert et al., (2007) reported that honors programs provide extensive and challenging academic experiences through increased interaction with peers, greater academic involvement, increased higher-order learning, and greater instructor feedback.

According to guidelines developed and approved by the National Collegiate Honors Council, a fully developed honors program should constitute 20 to 25% of a student participants total course work and relate to effective completion of general education, as well as, degree area requirements (Spurrier, 2008). However, Sederberg (2005) reported that most honors programs predominantly offer courses that fulfill general education requirements of the core university curriculum with fewer offerings at the departmental level. To this end, an introductory animal sciences course at The Ohio State University was restructured to enhance the depth and breadth of the learning experience of honor program participants. The objectives herein are to 1) describe, in detail, the development and first offering of the departmental honors course; and 2) discuss the findings of the student evaluations of the course and course components.

Methods

During autumn quarter of 2009 a survey and post-course questionnaire were administered to students enrolled in an introductory level animal sciences course designed for students in The Ohio State University honors program. The five credit hour course met 48 minutes, four times per week for lecture; 108 min, one time per week for laboratory; and 48 min, one time per week for recitation. Students met outside of regularly scheduled class time for individual laboratory training for a course designated team-based research project. The course, available to first and second year animal sciences majors and non-majors, concerned the use of animals and introduced basic principles and practices that allow humans to successfully coexist with animals in captive and controlled environments. The importance of animals was depicted throughout history and modern society as sources of food, clothing, knowledge, energy, power, transportation, companionship, entertainment, service, and capital. The course centered on the human-animal relationship and fundamental knowledge of the principles of behavior, nutrition, genetics, reproduction, lactation and production of food animal species, as well as horses and lamoids. The course is administered on-line through the universities course management system. A maximum of 25 spaces were available for enrollment during autumn quarter.

Honors Concept and Course Components

The goals of The Ohio State University honors

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program are to enrich intellectual development of high-ability students by enhancing the rigor and breadth of a student's academic experience. Admittance into the program required a composite score of 30 or greater on the ACT or 1340 or greater on the SAT, ranking in the top 10% of their high school graduating class, completion of the Honors Affiliate Application through the University Honors Center, and maintenance of a 3.40 cumulative point hour ratio (CPHR).

The primary aim of introductory animal sciences for honors was to foster student's interest in basic science by offering a course focused on student-centered learning and the foundation of research, while meeting the goals of the honors program. To this end, four primary course components were used. The first consisted of lectures presented by the instructor of the course on fundamental topics of animal sciences (Table 1). The second required students to read *Portrait of a Burger as a Young Calf* (Lovenheim, 2002) and evaluate the science that supports or refutes selected excerpts from the book by reviewing peer-reviewed scientific literature concerning the topic (Table 2). The goals were for students to think critically regarding concepts and situations and gain an appreciation of how to interpret scientific data. Additionally, the second component fostered self-directed learning and promoted effective writing skills.

The third component was laboratory sessions that built on lecture concepts by allowing students to 1) visit the university animal centers that maintain animals of agricultural significance, 2) learn of the production practices employed and routine activities that are required to maintain these animals, and 3) provide hands-on experiences to explore research methodology and technology that enhance the well-being of animals kept for human benefit and ensure quality of the products attained. Sessions provided opportunities in comparative physiology of reproductive and digestive anatomy, quality assurance evaluation of fresh harvested pork, clinical mastitis testing, and determination of feed preference in chickens as influenced by feed color. Tissues and samples used for activities were collected in

Table 1. Topics Covered during the Quarter in the Lecture Component of an Honors Introductory Animal Sciences Course at The Ohio State University

	Topics
1	Importance of animals to humans: social, agricultural, and medical uses.
2	Domestication: when, how, and why?
3	Animal form and function: establishment of breeds and the role of animals in human society as directed by their physiology.
4	Animal behavior and its role in defining welfare.
5	Nutrition: nutrient requirements, digestive physiology, and the importance of different digestive strategies.
6	Organization of biological systems from molecular structures to physical features: DNA as the blueprint of life.
7	Genetics and application of genetics for animal breeding.
8	Biotechnology: progress, applications and limitations.
9	Principles of reproduction and assisted reproductive technologies.
10	Lactation strategies: nutritional and immunological support of the young and provision of food for humans.
11	Current status of the animal industries.

Table 2. Selected Excerpts from *Portrait of a Burger as a Young Calf* (Lovenheim, 2002) Used in the Scientific Evaluation Component of an Honors Introductory Animal Sciences Course at The Ohio State University

	Selected Excerpts
1	In one study of domesticated cows, contact between cow and calf for as little as five minutes after birth was shown to produce a strong maternal bond; cows did not break this bond with a calf even when another calf was born a year later (p. 16).
2	In about 85% percent of cases in which a female calf is born twin to a male, the male hormones circulate into the unborn female and render her sterile (p. 26).
3	Artificial insemination is used in 90 percent of US dairy herds, and, partly as a result, yearly milk production in the US has grown from 7,000 pounds per cow-about 814 gallons-in 1960, to about 22,000 pounds today-more than 2,500 gallons (p. 35).
4	Researchers at Colorado State University studying sixty-nine Angus bulls collected by electric stimulation found, by measuring vocalizations and release of hormones, that the higher the voltage and the less skilled the person handling the equipment, the more disinclined the bulls were to tolerate the electro-ejaculation procedure (p. 36).
5	Animal scientist who study social relationships among cattle have found that when moving from barn to milk parlor, dairy cows tend to travel in a consistent order: dominant cows in the lead, subordinate cows in the rear. Compared with the cows in the front, those in the back are usually very young or very old, smaller and more timid. Rearship is more consistent than leadership (p. 83).
6	Cows produce nine to eleven pounds more milk per day on bovine somatotropin (bST). Importantly, bST also lengthens a cow's lactation. Normally a cow begins to "dry off" – produce less milk- about ten months after calving. With BST, however, cows keep lactating (p. 87).
7	Many cases of bovine lameness involve inflammation or injury to the hoof or the skin between the hooves. Hind feet tend to be affected more often than front feet. Experts attribute some of the problem to genetic manipulation designed to increase milk yield by producing larger udders (p. 98).
8	If you decrease fiber by chopping the plant too small, fiber digesting bacteria will decline and other types of bacteria, such as starch-digesters, will increase. Too many of these, in turn, can cause lactic acid to enter the bloodstream and soften foot tissue, causing the cow not only to produce less milk, but also to become lame (p. 106).
9	A corn diet can cause metabolic disorders and disease such as acidosis, bloat, and most dangerous, liver abscess. You can feed a steer on a total mixed ration. It'll head you toward the finish line just like corn. It'll just take a little longer to get there (p. 143).
10	(When fed corn) They have a rumen functioning at a very low efficiency, maybe ten percent. There's still a population of bacteria that are wanting to digest fiber and forage, but they're not being fed that, so the calf becomes more like a simple-stomached animal (p. 153).

conjunction with planned harvests or purchased. Briefly, reproductive tracts of cattle and laying hens were used to compare and contrast anatomical features of viviparous and oviparous species. Enzyme immunoassay (EIA) was performed on unknown plasma samples from female cattle according to the manufacturer's instructions (Assay Designs, Ann Harbor, MI) to quantify progesterone concentration to determine stage of the reproductive cycle. Digestive tracts of pigs and sheep were used to study and measure anatomical features of non-ruminant and ruminant digestive systems. Quality evaluation of fresh pork was performed on carcasses chilled to 4° C for 24 hours and ribbed between the 10th and 11th ribs (NPPC, 2000). Measurements of pH using a portable pH meter, subjective visual color score (NPPC, 2000), L*-value (Minolta Chroma Meter CR-310, 50 mm diameter orifice and D65 light source; Minolta Corp., Ramsey, NJ), and water holding capacity (Kauffman, et al., 1986) were used as quality indicators. To conduct clinical mastitis testing, somatic cell count was determined by the indirect measurement of the California Mastitis Test (CMT) on collected milk samples (Hogan, 1987). In the occurrence of a score of 1-3, indicative of reduced milk quality in the presence of elevated somatic cell counts, milk samples were cultured using selective agar media for the determination of gram-negative or gram-positive bacterial species. Organisms were further identified by the catalase slide test, CAMP test, or coagulase test (Hogan, 1987). To investigate the ingestive behaviors of young and mature poultry, broilers (n=4) and roosters (n=4) were observed for one hour after provided standard mash feed to determine the number and length of times that the bird visited the feed trough. Weight of the feed before and after the observation period was measured to determine feed disappearance. Students completed laboratory sessions in teams of three to four. Observations and data collected (used for descriptive statistics) were presented in abstract form.

The fourth course component engaged students in a descriptive research study designed to extend students' knowledge of selected course concepts and provide further experience in a laboratory environment. Students used histological techniques to study cell and tissue biology and the understanding of organ system structure as it relates to animal development and function. Working in teams of three to four students, each team selected an organ system (musculoskeletal, digestive, reproductive, etc.) for study of a specific organ or region of the system. Tissues were collected in conjunction with planned harvests and processed for histological preparation using standard procedures. At the time of collection tissue samples were immediately placed into a formalin-free fixative (*Prefer*, Anatech LTD., Battle Creek, MI), followed by dehydration and embedding in *Paraplast* X-TRA (Fisher Scientific Co.). Tissue sections were cut using a microtome (AO Spencer) and stained using Harris hematoxylin and eosin Y (*Protocol*, Fisher Scientific Co.). Histological preparations were examined and digital images of the microscopic sections recorded. Students were required to explore how the structure relates to the specific functions of the tissues. Comparisons among species and the study of common pathologies were encouraged. Individual written reports and oral presentations by team members were presented at the end of the quarter in an open-forum.

Course grades were determined from equally weighted examinations (n=3), writing compositions, laboratory abstracts, oral presentation of histology findings, and participation. Exams were mixed-format consisting of objective (multiple-choice, fill-in-the-blank) and subjective (short-essay) assessment. For subjective grading, the quality and completeness of the answer relative to all other answers provided by students in the class were considered. Exam questions were written with consideration of Bloom's taxonomy for the cognitive domain (Anderson et al., 2001).

Survey and Post-Course Questionnaire

On the first day of class a survey was administered with the purpose of obtaining data on student demographic variables (gender, major classification, and career objectives), motives for course enrollment, and species of interest (n=13). The post-course questionnaire was developed to determine student perception of the value of the course and course components and was administered the last day of class (n=13). Specifically, students were asked to rank prior experience with animal science concepts and what was learned following course completion and rate course components using a 5-point response scale. Statistical analyses were performed by ANOVA using the mixed model (PROC MIXED) procedures of SAS appropriate for random nested effects (version 9.1; SAS, Cary, NC) to determine differences in mean responses to the post-course questionnaire. Data are presented as means ± SEM with $P \leq 0.05$ considered significant.

Results and Discussion

All students enrolled on the initial start date of the course completed the course. Demographics of honors students enrolled in the course were similar to previous reports of animal sciences students (Edwards, 1986; Mollett and Leslie, 1986). Seventy-seven percent of the class was female and the majority of students (9 of the 13) reported primary interest in companion animals (dogs and cats) and horses. It is interesting to note that none of the honors students reported a career interest other than veterinary medicine. Although there were limited observations in the current study, unpublished survey data by the authors indicate that nearly 85% of honors students enrolled in animal sciences between 2006 and 2008 reported career interests in veterinary medicine. The percentage of honors students inter-

ested in the veterinary profession is greater than the percentages previously reported for animal sciences students (Edwards, 1986; Mollett and Leslie, 1986). The reason behind increased interests in this career by honors students is not known. Tidwell (1980) reported that nearly 50% of high-ability pre-college students stated objectives to pursue postgraduate studies. Furthermore, although not determined for this study, differences in career aspirations may reflect differences in rural, suburban, or urban demographics between the populations of students. It is well documented that an increasing percentage of animal sciences students are identifying as urban (Reiling et al., 2003). According to Howley (2006) urban students are more likely to pursue postgraduate studies relative to their rural counterparts.

Table 3. Questions and the Responses by the Students Completing an Honors Introductory Animal Sciences Course at The Ohio State University

Question	Mean ± SE[z]
Rate your experience with animal science concepts before taking this course (minimal experience = 1) (considerable experience = 5)	2.77 ± 0.24
This course taught me a great deal about domesticated animal species (strongly disagree = 1) (strongly agree = 5)	4.46 ± 0.24
This course taught me a great deal about animal science disciplines (strongly disagree = 1) (strongly agree = 5)	4.69 ± 0.24
Rate the following components of the class toward your overall learning experience (of little value = 1) (very valuable = 5)	
Lecture	4.85 ± 0.24[a]
Animal facilities tours	3.96 ± 0.24[bc]
Laboratories, overall	4.18 ± 0.26[b]
Comparative reproductive physiology	4.23 ± 0.24[ab]
Comparative digestive physiology	4.00 ± 0.24[b]
Quality assurance	4.69 ± 0.26[a]
Mastitis diagnostics	4.09 ± 0.26[ab]
Avian behavior	4.00 ± 0.24[b]
Scientific evaluation	3.85 ± 0.24[c]
Histology project	4.35 ± 0.24[b]
How frequently did you participate in team activities prior to this course (not at all = 1) (frequently = 5)	3.85 ± 0.24
Did you enjoy participating in team-based activities during this course (not at all = 1) (really enjoyed = 5)	4.34 ± 0.24
How frequently did you use the supplemental on-line content (not at all = 1) (frequently = 5)	3.38 ± 0.24

[z]Values are means ± SE, n = 13. Labeled means with superscripts without a common letter differ for course components or individual laboratories listed using analysis of variance, $P < 0.05$.
[y]The course was administered through the universities course management system, which provided students access to course notes and other course materials.

Generally, students reported minimal experience with animal science concepts prior to enrolling in the course, but agreed that the course greatly increased their knowledge of domesticated animal species and animal sciences disciplines (Table 3). Student ratings of course components (Table 3) showed that lecture was perceived as most valuable ($P < 0.05$). The histology project received the second greatest rating and was perceived to be more valuable than the scientific evaluation, but did not differ from the perceived value of the laboratory component overall. Although the perceived value of individual laboratories was similar in most instances, the quality assurance laboratory received the greatest rating and was considered more valuable than the comparative reproductive physiology and avian behavior laboratories ($P < 0.05$). Murry and Downs (1998) demonstrated positive correlations between students perceived value of course content and students' academic achievement in an introductory companion animal course. Earned scores did not appear to be a primary factor underlying ratings for individual course components of the current study. While the exam average, reflecting graded assessment of lecture content, was 80.4% ± 8.7, average scores earned for the laboratory and scientific evaluation were 94.0% ± 4.5 and 91.5% ± 3.8, respectively.

Studies suggest that classroom lecture is not an effective teaching format, promoting passive learning without the development of critical thinking abilities that are needed for students to become life-long learners (Amador and Görres, 2004). However, it should be recognized that lecture format is relevant to delivery of introductory material when students lack the background that is needed to facilitate higher-order learning (Deeter, 2003). According to Blooms Taxonomy (Anderson et al., 2001), learning is hierarchical. Rote memorization that demonstrates basic knowledge represents the first tier of the learning process that must precede the more sophisticated stages of critical thinking. Lecture format facilitates student achievement of the first tier of Blooms Taxonomy and lecturing remains a dominant teaching method in the university classroom (Lammers and Murphy, 2002). Students' attitudes toward lecturing are reflected by perceived quality of the lecture (Brown and Atkins, 1988). Ineffective lectures are commonly associated with large enrollment courses that demonstrate limited lecturer-student interaction and are void of classroom activities for engagement (Sullivan and McIntosh, 1996; Ebert-May et al., 1997). The lesser enrollment of honors introductory animal sciences promoted lecturer-student interaction and likely contributed to

the greater perceived value of lecture content relative to other course components.

Although lectures are effective for dissemination of information, they are less effective toward promoting students analysis, synthesis, integration, or application of information (Verner and Dickinson, 1967). These higher forms of learning can be incorporated through reading and writing exercises and to this end; the scientific evaluation was included in the course. Reading comprehension and effective writing are important outcomes of undergraduate education. Reading serves to deliver new knowledge, promotes assimilation of personal knowledge with that of others, and allows for synthesis of information (Carter-Wells, 1996); while writing improves communication, enhances reasoning, and increases organizational skills (Ryan and Campa, 2000). According to Haug (1996) students need to develop writing skills within their discipline, a sentiment shared by Aaron (1996). Writing across the curriculum demonstrates the relevance of science toward a specific discipline and is viewed more effective when placed in a meaningful disciplinary context (Ryan and Campa, 2000). In an introductory soil sciences course, 89% of student respondents reported that writing within their discipline promoted learning and viewed writing as an important aspect of their undergraduate education (Motavalli et al., 2003). Interestingly, studies suggest that students fail to perceive the value of reading contributing to a literacy among college students (Goodwin, 1996). Furthermore, reading is reported as one of the skills least addressed in colleges of agriculture (Lamberson and Smith, 2005). Limited reading exposure during development and disconnect between reading assignments and student's personal interests are implicated in students lack of reading initiative (Goodwin, 1996), and it is plausible that the lesser perceived value of the scientific evaluation by students may be attributed to the required reading of the selected text. Indeed, the selected text for the course emphasized food animal production, whereas the predominant interests of the class was companion animals or horses.

While students generally enjoyed participating in team-based activities during the course, fewer students reported that they had frequently engaged in this type of activity prior to the course (Table 3). Team-based learning is an active learning approach that allows students to explore concepts and evaluate relationships between concepts and is viewed as an effective technique in enhancing student learning (Millis and Cottell, 1998). Furthermore, forms of active learning that involve team-based approaches establish greater positive relationships amongst peers, promote increased depth of understanding, and result in greater academic success when compared to individualized forms of learning (Johnson et al., 1994). The overall outcome is providing graduates that have more developed social skills to function efficiently in teams, communicate effectively, and think critically to solve problems, which are valuable skills that undergraduate programs aim to instill in their graduates (Deden, 1998; Andreasen and Trede, 2000). It is interesting to note, that although successful completion of team-based activities required additional student participation outside of regularly scheduled class time, all students reported that the time spent on the course was valuable (data not shown).

Summary

We acknowledge the limited number of students involved in assessing the quality of the course; however, to our knowledge this is the first report of student perceptions of an honors course in the animal sciences. The course provided learning experiences for undergraduates that promoted increased knowledge of domesticated animal species and animal science disciplines, developed reading and writing skills, and encouraged team work as a valuable skill that will continue to serve students in their academic pursuits. This study indicates that the instructional strategies used in the delivery of an honors course in introductory animal sciences are positively perceived by students.

Literature Cited

Aaron, D.K. 1996. Writing across the curriculum: Putting theory into practice in animal science courses. Jour. Anim. Sci. 74: 2810-2827.

Amador, J.A. and J.H. Görres. 2004. A problem-based learning approach to teaching introductory soil science. Jour. Nat. Res. Life Sci. Educ. 33: 21-27.

Anderson, L W., D.R. Krathwohl, and B.S. Bloom. 2001. A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy of educational outcomes: Complete Edition. New York, NY: Longman Publishing Group.

Andreasen, R.J. and L D. Trede. 2000. Perceived benefits of an agricultural capstone course at Iowa State University. NACTA Jour. 44: 51-56.

Brown, G. and M. Atkins. 1988. Effective teaching in higher education. London, ENG: Taylor and Francis Group.

Carter-Wells, J. 1996. Raising expectations for critical reading. New Dir. Higher Educ. 96: 45-54.

Deden, A. 1998. Computers and systemic change in higher education. Comm. of the ACM 41: 58-63.

Deeter, L. 2003. Incorporating student centered learning techniques into an introductory plant identification course. NACT Jour. 47: 47-52.

Ebert-May, D., C. Brewer, and S. Allred. 1997. Innovation in large lectures-teaching for active learning. BioScience 47: 601-607.

Edwards, R.L. 1986. Background, career objectives, and performance of students in introductory animal science. NACTA Jour. 30: 35-37.

Goodwin, L. 1996. Aliteracy among college students: Why don't they read? ERIC Documentation Reproduction Services, Charleston, SC, 2-20.

Haug, M. 1996. How to incorporate and evaluate writing skills in animal science and dairy science courses. Jour. Anim. Sci. 74: 2835-2842.

Howley, C.W. 2006. Remote possibilities: Rural children's educational aspirations. Peabody Jour. Educ. 81: 62-80.

Johnson, D.W., R.T. Johnson, and E.J. Holubec. 1994. The nuts and bolts of cooperative learning. Edina, MN: Interaction Book Comp.

Kaczvinsky, D.P. 2007. What is an honors student? A noel-levitz survey. Jour. NCHC. 8: 87-93.

Kauffman, R.G., G. Eikelenboom, P.G. van der Wal, G. Merkus, and M. Zaar. 1986. The use of filter paper to estimate drip loss of porcine musculature. Meat Sci. 18: 191-200.

Lamberson, W.R. and M.F. Smith. 2005. Encouraging science reading beyond the curriculum. Jour. Anim. Sci. 8: 1972-1975.

Lammers W.J. and J.J. Murphy. 2002. A profile of teaching techniques used in the university classroom. Active Learning in Higher Education 3: 54-67.

Lovenheim, P. 2002. Portrait of a burger as a young calf: The story of one man, two cows, and feeding of a nation. New York, NY: Harmony Books.

Millis, B.J. and P.G. Cottell. 1998. Cooperative learning for higher education faculty. American Council on Education. Phoenix, AZ: Oryx Press.

Mollett, T.A. and E.K. Leslie. 1986. Demographic profile of students majoring in animal science. NACTA Jour. 30: 26-29.

Motavalli P.P., M.D. Patton, R.A. Logan, and C.J. Frey. 2003. Promoting environmental writing in undergraduate soil science programs. Jour. Nat. Res. Life Sci. Educ. 23: 93-99.

Murry, A.C. and M.O. Downs. 1998. An introductory-level companion animal care course: Student perception and subsequent performance. Jour. Anim. Sci. 76: 1976-1982.

NPPC, 2000.Composition and quality assessment procedures. In: Berg, E. (ed.). Des Moines: IA: Natl. Pork Prod. Council.

Reiling, B.A., T.T. Marshall, J.H. Brendemuhl, J.A. McQuagge, and J.E. Umphrey. 2003. Experiential learning in the animal sciences: Development of a multispecies large-animal management and production practicum. Jour. Anim. Sci. 81: 3203-3210.

Ryan, M.R. and H. Campa III. 2000. Application of learner-based teaching innovations to enhance education in wildlife conservation. Wildlife Soc. Bull. 28: 168-179.

Sederberg, P. 2005. Characteristics of the contemporary honors college. A descriptive analysis of a survey of NCHC member colleges. Jour. NCHC 6: 121-136.

Seifert, T.A., E.T. Pascarella, N. Colangelo, and S. Assouline. 2007. The effects of honors program participation on experiences of good practices and learning outcomes. Jour. Coll. Student Dev. 48: 57-74.

Spurrier, R. 2008.The newest "basic characteristic" of a fully developed honors program. HIP. 4: 191-197.

Sullivan, R.L. and N. McIntosh. 1996. Delivering effective lectures. JHPIEGO Strategy Paper No. 5, Baltimore, MD.

Tidwell, R. 1980. A psycho-educational profile of 1,593 gifted high school students. Gifted Child Quart. 24: 63-68.

Verner, C. and G. Dickinson. 1967. The lecture, an analysis and review of research. Adult Educ. Quart. 17: 85-100.