J. Dairy Sci. 97:6378–6381
http://dx.doi.org/10.3168/jds.2013-7826

Short communication: Characteristics of student success in an undergraduate physiology and anatomy course

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ABSTRACT

Several factors affect the success of students in college classes. The objective of this research was to determine what factors affect success of undergraduate students in an anatomy and physiology class. Data were collected from 602 students enrolled in the Agriculture and Life Sciences (ALS) 2304 Animal Physiology and Anatomy course from 2005 through 2012. The data set included 476 females (79.1%) and 126 males (20.9%). Time to complete exams was recorded for each student. For statistical analyses, students' majors were animal and poultry sciences (APSC), agricultural sciences, biochemistry, biological sciences, dairy science, and "other," which combined all other majors. All analyses were completed using the GLIMMIX procedure of SAS (SAS Institute Inc., Cary, NC). Gender, major, matriculation year, major by year interaction, gender by year interaction, and time to complete the exam affected final course grade. The significant gender effect was manifested in the final grade percentage of 75.9 ± 0.4 for female students compared with 72.3 ± 0.6 for male students. Junior males had final course grades comparable with those of females, but sophomore and senior males had lower final course grades than other combinations. Biology majors had a final grade of 82.4 ± 0.6 and this grade was greater than all other majors. Students classified as "other" had a final score of 74.4 ± 0.8, which was greater than agricultural science majors (69.5 ± 0.9). The APSC grade (72.6 ± 0.5) was higher than the agricultural science majors. Junior students had significantly greater final grades (76.1 ± 0.5) than sophomores (73.3 ± 0.6) and seniors (72.9 ± 0.9). All biology students had greater final grades than all other majors, but biochemistry juniors had greater final course grades than APSC, agricultural science, and dairy science juniors. "Other" seniors had greater final course grades than agricultural science seniors. The regression for time to complete the exam was curvilinear and suggests that highest exam scores were at about 90-min completion time. It may be that some male students need better preparation for anatomy and physiology and their educational preparation should mimic that of female students more in terms of advance-placement biology in high school. These results suggest that biology majors might be better prepared for animal anatomy and physiology than other students.
Key words: student success, physiology, anatomy, undergraduate

Short Communication

In upper-level undergraduate classes, instructors build upon concepts that students learned in previous coursework and should expect proficiency in academic skills/habits, and gender may play a role in this preparation. Gender inequities are found in high school where, currently, both boys and girls take equally demanding mathematics classes, but females are more likely to take advanced-placement courses in biology and chemistry than males. Girls also take more college preparatory and advanced-placement tests than boys (Buchmann et al., 2008). Gender inequity in college education has been of concern for incoming students for several years. Carbonaro et al. (2011) found that females have an 8.4% increase in college applications, but the admission rate for males and females is almost the same for 4-yr colleges; more females attend 2-yr colleges. In addition, about 4.5% more females receive a bachelor's degree compared with males and this may be traced back to their advantage in academic skills/habits obtained during high school. The student population majoring in animal sciences at Kansas State University (Manhattan) is approximately 70% female (Douthit et al. 2013) and this seems to be a trend nationally in animal science programs.

Factors studied to assess determinants of success in a genetics class included academic standing, major, and instructor (Bormann et al., 2013), but other factors also likely play a role (Gwazdauskas and McGilliard, 2014). Assessment completion times have been speculated to indicate proficiency with material. Anecdotal evidence suggests that students who complete exams quickly may not know the material well, whereas students who take

Received December 12, 2013.
Accepted June 26, 2014.
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the most time for an exam do very well. In contrast, Deiter and Pierce (1991) found that no significant relationship existed between students' finishing rank and their score in examinations in agricultural economics classes. Athanasou (1994) supported the idea that the time for test taking was an indicator of information processing. Exam-completion time needs further evaluation to determine if it is related to academic performance. The objective of this analysis was to determine factors that affect success in an undergraduate anatomy and physiology class.

Data were collected from 602 students enrolled in the Agriculture and Life Sciences (ALS) 2304 Animal Physiology and Anatomy course from 2005 through 2012, a core course for students in animal and poultry sciences (**APSC**) and dairy science (**DASC**) at Virginia Tech (Blacksburg). The course includes lecture- and laboratory-based portions. Majors of students at the time of completing the course were APSC (n = 346); agricultural economics (n = 12); agricultural sciences (n = 33); agricultural technology (n = 1); art (n = 1); biochemistry (n = 18); biological sciences (n = 70); crop, soil, and environmental science (n = 2); chemistry (n = 1); communications (n = 1); Commonwealth Campus (non-degree student status; n = 1); DASC (n = 87); English (n = 1); environmental policy (n = 1); food science and technology (n = 1); fisheries and wildlife (n = 2); forestry (n = 1); human nutrition, foods, and exercise (n = 1); history (n = 1); interdisciplinary studies (n = 4); mathematics (n = 1); management (n = 3); psychology (n = 9); sociology (n = 1); and university studies (n = 3). For statistical analyses the students' majors were APSC, agricultural sciences, biochemistry, biological sciences, DASC, and "other," which combined all other majors. There were 476 females (79%) and 126 males (21%). The year of study was sophomore, junior, or senior. The course lecture topics were homeostasis, cell structure and function, fundamental biochemical pathways, tissue structure and organization, the digestive system, the integumentary system, muscle physiology, the blood and heart, lymphatics, immunity, the nervous system, senses, the endocrine system, respiration, and the urinary system. Laboratories included gross anatomy; cell transport mechanisms and permeability; anatomy of the digestive system; the skeletal system; skeletal muscle anatomy; skeletal muscle contraction; cardiovascular anatomy and electrocardiogram; blood analysis; anatomy of the brain, spinal cord, and eye; reflexes and general senses; endocrine glands; renal anatomy and urinalysis; and bovine jugular cannulation and blood collection.

Final course grades were a composite of 4 lecture examinations (600 points), credit for written questions submitted at the end of lecture periods (50 points), 2 laboratory practicals (300 points), and weekly laboratory quizzes (100 points). The 3 lecture examinations administered during the semester had a time limit of 75 min and the noncomprehensive final examination at the end of the semester had a time limit of 120 min. Each lecture exam consisted of approximately 55% multiple-choice, 23% short-answer, and 22% true/false questions. The amount of time used by students to complete the exams was recorded.

All analyses were performed with PROC GLIMMIX of SAS (SAS Institute Inc., Cary, NC). The dependent variable was final course grade in the class. The independent variables were gender, major, year of matriculation, significant interactions of major by year and gender by year, time for taking the examination, and time squared. In initial analyses, other interactions proved to be nonsignificant, as did the calendar year effect. Freshmen (n = 15), graduate students (n = 4), and students majoring in the agriculture technology program (n = 1) were removed from the data set. Students majoring in agricultural economics; art; crop, soil, and environmental science; chemistry; communications; Commonwealth Campus; English; environmental policy; food science and technology; fisheries and wildlife; forestry; human nutrition, foods, and exercise; history; interdisciplinary studies; mathematics; management; psychology; sociology; and university studies were coded as "other" in the data set.

The significant gender effect ($P < 0.0001$) was manifest in the final course grade of 75.9 ± 0.4% for female students compared with 72.3 ± 0.6% for male students. Vallejos et al. (2012) considered the importance of motivation, the desire for success, satisfaction, social prestige, and the possibility of academic achievement in students. Attitude and motivation may explain gender differences for college-aged females, as it was shown that females are more likely than males to expect before high school to attain at least a bachelor's degree, plan to attend college right after high school, and expect to enter an occupation that requires a college degree by age 30 (Carbonaro et al., 2011). Also, Buchmann et al. (2008) indicated better high school preparation for college for females than for males in the rigor of coursework. In contrast, no gender difference existed in final course grades in an undergraduate genetics class (Bormann et al., 2013). But at the same institution, a tendency existed for females to have greater academic performance in an equine science class (Douthit et al., 2013).

The effect of major is shown in Table 1. Biology students' final score of 82.4 ± 0.6% was higher than that of all listed majors. Students classified as "other" had a final score of 74.4 ± 0.8%, which was higher than that of agricultural science majors (69.5 ± 0.9%). The