The Delta Kappa Gamma Bulletin
International Journal for Professional Educators

Fall 2013 • Volume 80-1

Future of Education
The Delta Kappa Gamma Bulletin

Editorial Board
Sigrún Klaara Hannesdottir, PhD, 2010-2014
Professor Emerita of Library and Information Studies
University of Iceland
Reykjavík, Iceland

Beverly J. Irby, EdD, 2010-2014
Texas State University System Regents' Professor
Professor, Educational Leadership and Counseling
Sam Houston State University
Huntsville, Texas

Angela E. Quinn, 2012-2016
Curriculum/Assessment Director
Pontotoc County School District
Pontotoc, Mississippi

Margaret Trybus, EdD, 2012-2016
Associate Dean, College of Graduate and Innovative Programs
Professor, Educational Leadership
Concordia University
Chicago, Illinois

Judith Merz, EdD, Editor
Doctoral Advisor, Educational Leadership
Nova Southeastern University
Ft. Lauderdale, Florida

The Bulletin, the official journal of The Delta Kappa Gamma Society International, promotes professional and personal growth of members through publication of their writings.

The Bulletin invites materials appropriate to the Society's purposes: position papers, applied and/or data-based research, reviews of literature, program descriptions, and other articles on announced themes or other topics of interest to educators; letters to the editor; book and technology reviews; poetry; and graphic arts.

Prose manuscripts for the Bulletin, a refereed journal, are reviewed by the Editorial Board and the Society editorial staff. Selection is based on the relevance of the topics addressed, accuracy and validity, contribution to the professional literature, originality, quality of writing, and adherence to Submission Guidelines (see page 59). Editorial Board members evaluate each submission's focus, organization, development, readability, and relevance to the general audience of Bulletin readers. Due to the diversity of the Bulletin audience, material that expresses a gender, religious, political, or patriotic bias is not suitable for publication.

Please send materials to bulletin@dkg.org or to Bulletin Editorial Staff, The Delta Kappa Gamma Society International, P.O. Box 1589, Austin, TX 78777-1589.

The Delta Kappa Gamma Bulletin (ISSN 0011-5044; USPS 715-650; IPM 0302295) is published quarterly each year by The Delta Kappa Gamma Society International, 416 West 12th Street, Austin, Texas. Mailing address: P.O. Box 1589, Austin, TX 78777-1589. Periodicals Postage paid at Austin, Texas. Subscription, U.S. $20 per year; single copies, $5 each. International dues include subscription to The Delta Kappa Gamma Bulletin. Views expressed do not necessarily agree with positions taken by The Delta Kappa Gamma Society International.

POSTMASTER: Send address changes to The Delta Kappa Gamma Bulletin
P.O. Box 1589, Austin, TX 78767-1589
The Delta Kappa Gamma Bulletin

Fall 2013 • Volume 80-1
Published by the Delta Kappa Gamma Society International

The Delta Kappa Gamma Society International promotes professional and personal growth of women educators and excellence in education.

Call for Submissions ..................................................... 4

From the Editor ................................................................. 5

Awards
2013 Achievement Award: Sigrún K. Hannesdóttir
By Beverly Helms, EdD, International President, 2012-2014

2013 Educators Award: Exit: The Endings That Set Us Free
By Sara Lawrence Lightfoot, EdD, reviewed by 2012-2014 Educators Award Committee

On the Theme: Future of Education
Preparing for the Future of Education—Equipping Students with 21st Century Skills: An Interview with Dr. Robin Fogarty
By Margaret Trybus

The Future of Education: Building Capacity for Success
By Sharon Harsh and Michael Mallory

The Keys to Future STEM Careers: Basic Skills, Critical Thinking, and Ethics
By Kathleen Ramsey and Barbara Baetge

Understanding Play as a Powerful Tool to Enable Learning: A Review of Einstein Never Used Flashcards
By Lindsey J. Cook

Gateway Tools: Five Tools to Allow Teachers to Overcome Barriers to Technology Integration
By Lauren Hammonds, Lisa H. Matherson, Elizabeth K. Wilson, and Vivian H. Wright

Enhancing the Future of Education by Actively Supporting Novice Teachers
By Delise Tongue and Joyce Swan

Chapter Checkup and Strengthening: The Colorado State Organization Model
By Loretta B. Kerr and Sue L. Pettit

Submission Guidelines ..................................................... 55

Submission Grid ............................................................... 56

© 2013 The Delta Kappa Gamma Society International. All rights reserved.
The Keys to Future STEM Careers: Basic Skills, Critical Thinking, and Ethics
By Kathleen Ramsey and Barbara Baetha

The United States has lost its competitive edge in math and science education (National Math + Science Initiative, 2013), and work in science, technology, engineering, and mathematics (STEM) is no longer a career of choice. Some studies attribute these trends to lack of student interest (Hall et al., 2011). The authors discuss their experiences and results of informal research that led to their position that students’ level of basic skills, ability to think critically, and ethical commitment are major factors in determining the success and continued interest of science majors.

Introduction

“In 2008, 31 percent of U.S. bachelor’s degrees were awarded in science and engineering fields, compared to 61 percent in Japan and 51 percent in China” (National Math + Science Initiative, 2013). In 2009, “28% of high school freshman declared interest in science, technology, engineering, and mathematic (STEM) careers, but only 12% were still interested as senior students” (NSF.gov, 2013). In 2011, a startling 55% of high school graduates were not ready for college-level math, and 69% were not ready for college-level science classes (NMS, 2013). The result is that 38% of college freshmen who declared as STEM majors do not graduate with a STEM degree (NMS, 2013).

National efforts to address the absence of STEM graduates have focused on funding, increasing participation of minorities and women, new curriculum, science-teacher training, and increased federal involvement (Forbes, 2012; NSF.org, 2012; PCAST, 2010). However, these efforts do not address the fundamental causes of failure of potential science majors that we have seen in our classrooms. In more than 5 years of working with more than 1000 students in community-college and university-class settings, we observed the deciding factor for success in science classes was whether the student possessed fundamental writing, math, and critical-thinking skills and an ethical commitment to persevere in a difficult course of study. We decided to explore these observations in detail by examining perceptions of students in introductory and advanced level science courses. Results for both populations were consistent with the thesis that interest alone was not the deciding factor for student success in science classes.

Research Methodology

Our informal research centered on two populations of students: 140 community-college students in six introductory biology-for-majors courses, and 60 university students
in upper-level biology courses, including Entomology, Invertebrate Zoology, Microbiology, and Environmental Issues and Ethics. The upper-level courses were a mixture of on-ground and online classes. The same instructor taught both course levels, providing consistent grading criteria across the groups.

Most introductory students reported that they had graduated from area high schools or been home-schooled (2%) in the past 2 to 3 years. About 5% reported they had been out of school for some time. We observed the student population was predominantly white non-Hispanic, approximately 15% Latino, and 2% other minorities, including Asians and African Americans. These demographics were consistent with enrollments in other sections of this course in the department and the surrounding area. In 2012, the average income within a 20-mile radius of the college was $78,668 and, within a 5-mile radius, $96,160 (The Woodlands Corporation, 2013). Entrance requirements to the college are an SAT of 1070 with a 500 Verbal/Critical Reading and 500 math score (LSCS, n.d.). No college-level math or writing classes are required for enrollment in this introductory biology course for majors.

Unfortunately, despite emphasis on constructive activities and varied facilitation methods, the success rate for the introductory course averages 50%. This is comparable to statistics for the Biology Department for this course for approximately 2000 students over the past 5 years (Lone Star College-Montgomery, 2013).

Because the college does not offer upper-level biology courses, we used a second population of students from a university at which we also taught. The premise was that if students were enrolled in upper-level science classes, they most likely had mastered basic skills and would graduate with a science degree. The university has an open-enrollment policy and provides a series of entry-level classes in its first-year program to address student writing and math inconsistencies. It draws students from the Houston metropolitan area for on-ground courses and internationally for online courses. The student population is 34% Caucasian, 22% African American, 7% Hispanic, and 29% who do not report race (University of Phoenix, 2007). The average age of students is 28 years (University of Phoenix, 2007).

Two ethical systems were considered: duty-driven or deontological, and relativistic. In duty-driven ethics, a decision is right because it is what one ought to do (SEP, 2012). In this case, one ought to take steps in a regular and timely fashion to pass the course. In relativism, judgment and decision-making are relative to the person and what he or she believes is correct in a particular situation (SEP, 2008). According to the Barna Group (2002), approximately 75% of Americans are relativists. In the 18-25 year-old group, this number rises to 86%.

Data Sources
For introductory courses, we reviewed class exercises, laboratory reports, numerical and word problems, independent experimental-design study, and final grades. Documents in this

---

Kathleen Ramsey, PhD, is a former Diplomat of the American Board of Toxicology. Ramsey works as an ethical education consultant, faculty member for the University of Phoenix, and adjunct professor for Lone Star College System and Argosy University. kramsey@email.phoenix.edu

Barbara Baeth, EdD, a member and past president of Epsilon Omega Chapter in Alpha State (TX), is immediate past SW Regional Director and ISF Chair and the current Global Awareness Committee Chair in Texas State Organization. Baeth works as an education consultant and University of Phoenix faculty member. bjbaeth@email.phoenix.edu
course were submitted electronically. Thus, original work, graded assignments, and final grades for students in the six courses were available for review. After the first exam in each course, we conducted in-class discussions to explore reasons for achievement in the course. For students in upper-level classes, we reviewed course assignments, research papers, and grades. We also held discussions with students about potential career choices in the sciences.

Findings

When we examined data showing student achievement (see Data Sources), several factors appeared to affect students' success in science courses. These included basic skills in writing, math, and critical thinking; and ethical systems related to class preparation. Within each factor category, we analyzed data with respect to students' success in the courses, which translated to success in a science major.

Students in introductory courses indicated lack of familiarity with basic writing and mathematics skills. We observed that they struggled with critical-thinking exercises. Most students reported in class discussions that completing class work, including preparation for exams, was secondary to other activities, including emotional attachment to friends, responsibility to family, over-commitment at work, and failure to use study time efficiently. Within this pool of students, failure rate (i.e., a grade of D or F) for each class was 40-60%. This statistic was consistent with departmental findings for this introductory course over the past 5 years (LSC-Montgomery, 2013).

Students in upper-level classes fared better. In comparing student writing with established rubrics, we found good organization, mechanics, and content in research papers. Students indicated that they reserved an average of 16 hours per week for course work. This was consistent with a duty-driven ethic. Approximately 68% of students earned an A or B. Only 10% earned a D or F.

Writing. Introductory students provided a variety of written materials for assessment, including short answers, summaries, papers, notes on speakers, and laboratory reports. They demonstrated difficulty in constructing a proper paragraph. Formatting a paper with introduction, body with section headings, conclusion, and references was problematic. Our evaluation showed approximately 80% of the students did not begin the report with an introduction or thesis statement. Without focus, they rambled from one required element to another, often in a nonsequential fashion. Critical scientific aspects were included haphazardly. Identification of controls was frequently omitted, and treatment options were incomplete. Papers often ended abruptly without conclusion, leaving the reviewer wondering if students understood the problem.

In upper-level classes, students prepared research papers on a variety of topics.
Introductions generally included a short description of the elements in the paper and a thesis statement. The body addressed the elements of the assignment (e.g., description of the insect, members of the social order and jobs, structure, reproduction, and environmental factors) and usually used one basic level of headings. A conclusion and reference list followed. Some analysis was incomplete, and there was some confusion as to where the analysis stopped and the conclusion began, but, taken as a whole, papers conformed to rubric requirements and students scored well. With format and basic paragraph structure mastered, students were free to explore interesting aspects of the topic, and this exploration made the papers more interesting and engaging.

Mathematics. Introductory students were instructed in the Hardy-Weinberg basic equation \((p + q = 1)\), which determines the frequency of alleles in a population, where \(p\) = the frequency of dominant alleles and \(q\) = the frequency of recessive alleles in steady state. The equation \(p^2 + 2pq + q^2 = 1\) that shows the distribution frequency of homozygous dominant (\(p^2\)), heterozygous (\(2pq\)), and homozygous recessive individuals (\(q^2\)) is a bit more complicated but can be managed with basic addition and multiplication skills.

When students were provided with the information that the frequency of recessive alleles in a population was 30% (\(q = 0.3\)), most calculated the correct frequency of dominant alleles as 70% (\(p + q = 1\)). However, if students were told that there were 300 pink-nosed cars with a recessive trait in a herd of 1000 cattle, less than half could calculate the frequency of dominant alleles. If the instructor advanced the question to a determination of the frequency of heterozygous individuals (\(2pq\)) in the herd of cows, only about 5% of the students provided the correct answer.

Critical-thinking skills. Introductory students’ critical-thinking and problem-solving skills were measured by evaluation of the completion of an independent chemotaxis study using \(E. coli\). Students had to identify test sugars and prepare a proposal and methodology to assess \(E. coli\) sugar attraction. The format for proposals included purpose with thesis statement, literature research, rationale for sugar choice, laboratory procedures (provided by faculty), timeline, and bibliography.

We evaluated their proposals according to a rubric and noted a lack of understanding of the purpose of the study—to determine the key relationship between sugar structure and bacterial receptor site. Most students included parts of the experimental procedures in the proposal, but not all, making it virtually impossible to obtain meaningful data as students followed their own procedures.

In upper-level classes, students prepared research papers. For example, entomology students completed an integrated pest management plan. They studied and considered pests, crops, abiotic and biotic factors, development, behavioral patterns, and population dynamics to determine what methods best control the pest. They also performed risk/benefit analysis. Students completed cohesive documents in terms of rubric requirements.

Ethical systems and study dynamics. Not surprisingly, we observed a connection between success in class as measured by grade and the amount of time spent studying. More importantly, however, we concluded that patterns of study were directly related to the student’s ethical system, which determines priorities in decision-making. Those students who self-identified or made comments indicating they were duty-driven were more consistent in assignments and exam performance. They used external criteria for right and spent more time studying because studying was what they ought to do. Relativists, who used personal, internal criteria to determine what was right, had variable performance on assignments and inconsistent exam performance. They reported they studied less than
duty-driven students because studying was not necessarily right if the student believed something else was more important at the time and on a routine basis.

Typical college-level classes require outside study time equal to 2 to 3 times contact hours for mastery of the material. In other words, a 6-hour-per-week class requires 12 to 18 study hours (University of Michigan-Flint, 2007). In discussions with introductory students, we found most students studied between 4-6 hours per week. Students reported they were often distracted by friends, social media, family, and work. By contrast, the 6% of students who earned an A in the introductory classes reported spending 15-20 hours per week studying. They reported dedicated study and planning that, although flexible, held them to task. It was noteworthy that all homeschoolied students (2% of the students) fit in this latter category, with the exception of one who earned a B. There were few B students in these classes. Upper-level (senior) University students studied an average of 16 hours (University of Phoenix, 2013, p. 22).

Discussion

We used a variety of constructivist methods in the introductory biology course, including models, experiential laboratories, and project-based applications. Lectures were reinforced by student presentations. Students worked cooperatively on in-class activities, laboratory, and group projects. Supplemental Web-based information for the course included lectures, Web links, study guides, chapter notes, sample proposals, interactive tools, and an e-text with electronic flash cards, practice quizzes, and videos. We discussed study skills and time management frequently in class, and departmental counselors offered one-on-one evaluations and custom plans. Faculty led 1-hour study sessions three times a week. None of these strategies affected success rate in these introductory classes, which has remained in the 40-60% range for the past 5 years. Clearly, in addition to basic skill level, an additional element was necessary to student success—ethical commitment.

Writing. Communication is essential in the scientific community and in STEM careers. Inability to produce a cohesive paper in a STEM class means more than lack of basic elementary school skills. It means that individuals cannot communicate with employers and colleagues domestically and globally. It means they cannot write a grant application or corporate proposal. On a global stage, good written communication skills are an asset.

Mathematics. Advanced mathematics was not required in introductory biology classes, but fundamental skills were. The Hardy-Weinberg equations necessary to determine genetic variation at equilibrium require basic math. We explained Hardy-Weinberg equations to students using a variety of methods, including lecture overview, followed by discussion, problem sets, and individual coaching. A group, in-class activity encouraged students to solve sample problems and share the results in presentations to the class. Students were able to use glass beads or soybeans in a laboratory exercise to determine various Hardy-Weinberg frequencies. We provided YouTube videos and links to the Khan Academy (a free Web-based instruction site with an extensive video library, interactive challenges, and assessments at www.khanacademy.org) for additional study. None of these methods or study aids improved understanding as measured by success on the exam questions.

Students who initially were interested in biology became discouraged when they could not complete simple math calculations. The deficiency might have been an issue with basic math skills, reading comprehension, critical thinking—or all three. Regardless, students moved on to other majors.
It is unreasonable to expect instructors in STEM courses to provide sufficient remedial services to enable students to complete work in class. Does one teach basic math or the course content of population genetics? With increasing pressure from college administrators to raise success rates, faculty has to reduce the rigor of class material, which in turn makes American students less competitive in the global STEM career market.

Critical-thinking skill. Critical thinking is a fundamental skill in a STEM career. In the introductory chemotaxis assessment, students were unable to make the connection between the scientific question (Was E. coli attracted to different sugars?) and the need to follow experimental procedures that led to reliable data from which valid conclusions were drawn. Experimental procedures were inconsistent even though they were discussed in class, explored in two laboratory practice sessions, and posted on the class Web site.

Basic application of scientific method and precision are necessary for STEM careers. As students struggle with addressing these requirements, they become discouraged and frequently drop the STEM major.

Ethics and class preparation. There was a time in the United States when duty-driven ethics prevailed. What was ethical or right was to ask what you could do for your country, not what your country could do for you (NASA, 1963). Many entered STEM careers and assisted in reaching the moon, not because it was easy, but because it was a hard (NASA, 1963). STEM careers flourished, as did research and development of technology for students with the Apollo 13 right stuff. Much of the STEM curriculum is difficult. Solid fundamentals, time, and effort, along with an ethical commitment to right in the long-term are necessary for achievement. Duty-driven ethical systems support this endeavor.

Ethics are quite different today. Relativism is person-centered. To determine what is right, relativists use criteria that include personal preference, emotion, bias, culture, socioeconomic group, gender, age, and any other factor that the individual wishes to use. Right for relativists depends on a variety of personally oriented criteria—time with friends and family, sporting activities, social media participation, work, and any other factor the student deems important. This ethical system focuses on short-term outcomes, not the long-term view needed to prepare for a STEM career, which requires studying regardless of whether one has personal activities he or she would prefer to be doing. Lack of preclass preparation in STEM classes is problematic for several reasons. For example, sections on DNA replication, translation, and transcription are specific and complicated. Without preclass preparation and even a cursory understanding of terminology and function, students gain little from the initial presentation, discussion, or constructive activities.

Looking to the future of education, we concluded that instruction and drill to pass standard tests in elementary school simply will be enough for success as a STEM major... A true commitment to increasing the number of American STEM graduates begins with producing students who have basic skills in writing, mathematics, and critical thinking, as well as an ethical commitment of duty to achieving long-term goals.
Preparing for a STEM career requires a long-term commitment, which relativistic ethics does not easily support. STEM careers are disciplined careers in creativity. Without the discipline and without ethical, duty-driven commitment, creativity achieves no measurable goal.

Conclusion

In 2012, the World Economic Forum ranked the United States globally as 27th in math and science education, only slightly ahead of Morocco, Greece, and Romania (World Economic Forum, 2012). With poorly educated American students, many of the 1.2 million science and technology jobs available in the United States in the next 5 years, will go to foreign graduates (STEMConnector, 2012).

Based on our observations and survey of students, we concluded that the key to improving student numbers and performance in STEM courses is to produce students who possess a basic skill set that supports the endeavor. Introductory students who lack basic writing, math, critical thinking, and ethical commitment are not successful even if they start the class with enthusiasm. Furthermore, much of the current emphasis in increasing the number of STEM students focuses on constructivist practices and projects. From our observations and informal research, we conclude that these practices will not produce the desired results for students who have weak basic skills.

Such skills were more evident in upper-level students in university biology and science courses, who exhibited the ability to write clearly, perform math calculations, and develop research proposals and papers. Perhaps more importantly, however, these basic skills were supported by a more duty-driven approach to classes. Ethically, many today live in the world of relativism. It is no longer common to see a duty, a clear right, to spend 15-20 hours per week per course to learn material, complete assignments, and integrate concepts from STEM courses into students’ thinking. Upper-level students were willing to put in the time and effort in the short term to be successful in the long term—a duty-driven approach.

Looking to the future of education, we concluded that instruction and drill to pass standard tests in elementary school simply will not be enough for success as a STEM major. If a student cannot read or write at grade level or complete simple addition, subtraction, multiplication, and division word problem, and if a student lacks commitment to long-term achievement, he or she has little chance for success in a STEM major or career. A true commitment to increasing the number of American STEM graduates begins with producing students who have basic skills in writing, mathematics, and critical thinking, as well as an ethical commitment of duty to achieving long-term goals.

References


