Rekha Natarajan is an instructor in the Mathematics Department at Kansas State University, coordinating college algebra. She received her B.S. and M.A. in mathematics from Arizona State University, B.S. in secondary education from Kansas State University, and is currently a doctoral student in the Mathematics Department at KSU. Her research area is undergraduate mathematics education.

Mrs. Blythe Marlow Vogt, Kansas State University

Blythe Vogt joined the faculty in architectural engineering and construction science and management at Kansas State University in Jan. 2008. She received her B.S.A.E from K-State in 2001 and completed her M.S.A.E. from K-State in 2010 related to curriculum development in architectural engineering and construction science with regards to building information modeling. Vogt is currently pursuing her Ph.D. in electrical and computer engineering with an emphasis in engineering education/outreach under the supervision of Dr. Noel Schulz. During 2001-2008, Vogt was employed full-time with Affiliated Engineers, Inc., a national engineering consulting firm in Madison, Wis. where she held several roles, including project manager, project engineer, commissioning agent, conference speaker, and business development/marketing liaison. She also collaborated with the University of Wisconsin’s Construction Engineering & Management Department as an adjunct faculty, teaching one course each fall semester related to building systems from 2002-2007. Vogt was awarded the 2008 National Electrical Contractors Association Faculty Award for her instruction and mentoring of construction science students in CNS535 Electrical & Lighting, a course focused on the electrical exposure and education of future construction professionals.
From Defense to Degree: Accelerating Engineering Degree Opportunities for Military Veterans

Motivation

This paper addresses curricular issues involved in integrating post-9/11 veterans into the engineering workforce. A 2009 NSF Workshop on Enhancing the Post-9/11 Veterans Educational Benefit\(^1\) indicates that new, more generous veterans’ educational benefits create an opportunity to expand the technical workforce while benefitting those who have served our country. The workshop further indicates that the veterans include a diverse and qualified pool of future talent for the nation’s engineering and science employers.

Technical focus

Based on this opportunity to involve veterans in the workforce, researchers have developed a program to help integrate veterans into electrical and computer engineering degrees. The initial technical focus will be in the renewable energy and energy distribution systems areas, which has been identified as a critical area where there is a large projected shortage of trained technical personnel. A 2008 NSF Workshop on the Future Power Engineering Workforce\(^2\) indicated “a serious need is emerging for more power and energy engineers to: a) replace retiring engineers so that critical expertise is maintained; b) meet rising infrastructure construction needs; c) modernize the grid as communications, computing, and electric energy technologies converge; d) help stem the tide of electric equipment manufacturing moving off-shore, and; e) solve arising engineering challenges, such as the development of advanced power electronics and energy conversion systems, new generation and storage technologies, and the integration of those technologies into the grid.”

The IEEE Power and Energy Society\(^3\) has also indicated that “Immediate action must be taken to avoid letting a growing shortage of well-qualified electric power engineers slow progress in meeting critical national objectives.”

Electrical utilities in the geographic region and engineering firms in the electrical power arena also recognize this upcoming critical workforce shortage. This resulted in the formation of an industry consortium called the Kansas State University Electrical Power Affiliates Program (EPAP) in 2008. EPAP is a consortium of industry leaders committed to the continued excellence of engineering education in the area of electrical power and energy systems. The program can be leveraged to help with various aspects of this project, including the recruitment seminar, internships, and research projects. At the recruitment seminar, EPAP members will be able to discuss career opportunities for graduates in the power and energy field. They can also provide realistic technical problems or scenarios that can be presented to participants so that they can better understand the current challenges in this field. Students already in our program will have the opportunity to participate in research projects, internships, or co-ops sponsored by EPAP members. This program has funded multiple student projects, in addition to field trips to...
member facilities and national conferences and a mini Career Fair for the electrical power
industry.

The energy systems emphasis builds on the existing expertise of the faculty at Kansas State
University. Energy systems is one of the five areas of specialization in the electrical engineering
program and attracts almost 50 percent of the undergraduate students. In addition, the
department offers a master’s degree with an energy systems emphasis. This master’s program
has been offered via distance education since 1992, and has approximately 25 off-campus
students per semester. Currently the energy systems program produces approximately 15 to 20
bachelor’s degrees and five on-campus master’s degrees, and 7 to 10 off-campus master’s
degrees per year.

Accelerated Bachelor’s Degree

This paper will focus on the accelerated track for military veterans into bachelor’s degrees in
engineering. It is important to have contact with the military veteran prior to their arriving on
campus to begin their schooling. This allows an initial thorough evaluation of the veterans’
training, experiences, and expertise to be conducted with the option of granting academic credit
where appropriate. Current policies give little credit for military experience or training. One
issue with the use of military credit is that most of the academic credit is ungraded. Current
policies at many universities do not recognize courses that are evaluated as credit/no credit. A
possible avenue to overcome these rules is the use of advanced placement exams (where they
exist) and university generated quiz-out exams. The American Council on Education directory
and regional university credits for community college work also provide a resource to determine
class equivalency.

The next step will be to use the initial evaluation to identify areas where the veteran has the
technical background but may be lacking the necessary mathematics or has not used the
mathematics for a long time. An existing mathematics placement exam will be used to evaluate
a veteran’s mathematical abilities. Pre-tests will assess veteran’s weaknesses Online review
modules are being developed for review and extra practice in an individual’s identified
weaknesses, and post-tests will be administered to show knowledge capture. Together this
process will better prepare veterans to enter the mathematics sequence at the calculus level.

The creation of accelerated courses specifically for veterans enrolled in the program will be
another aspect used to accelerate degree completion. Veterans may have a base of technical
knowledge acquired through the technical nature of their military service. Assigning them to
introductory level courses with traditional freshman and sophomore students does not respect
their technical expertise nor challenge their capabilities and accustomed pace. The development
of subject based online tutorials is being used to accelerate the veteran’s entry into the math
sequence and the circuits sequence. These tutorials will include videos of laboratory exercises to
insure that veterans understand the equipment and terminology used in the introductory courses.
Additional online courses will be developed in the area of computer based tools including
Matlab, P-Spice, and Verilog (used in introductory course taken by all electrical engineering
students.)
The first task is to develop the mathematics review modules. This involves putting together video clips using Camtasia recording software and coding in PHP to help organize key features of the rational expressions review module. We have an undergraduate computer science worker who has been working solely in PHP and coding two modules, one covering order of operations and the other on the distributive property and rational expressions. In addition, two more review modules are complete, covering the topics of composition of functions and trigonometry. Future plans include testing these modules and placing them on their own webpage specifically for use by incoming veterans into the electrical engineering program; we will also be developing additional modules in the areas of complex numbers, exponential functions, and graphing. We will be collecting data on student performance to analyze how these modules are helping incoming veterans.

A similar effort has been started for review modules dealing with circuit theory. We have used paper based exams based on the final exam in the introductory circuits class. As an example a United States Navy veteran has successfully gotten credit by exam for the introductory circuits class. This exam opportunity was based on his U. S. Navy electrical circuits background and an extensive review of the course material.

Another aspect of this project is the inclusion of summer internships for participants. These will be provided by members of EPAP as discussed earlier and by funded research projects at the university.

Kansas State University and the Military Environment

Kansas State University is near a major U.S. military installation and has more than 60 years of experience providing educational opportunities to military personnel and their families. The university provides academics, activities, services and support for military families. Kansas State University has been ranked among the most military-friendly universities in the country by Military Advanced Education magazine and by G.I. Jobs magazine. The military installation is a 15 minute drive from campus. In addition courses are offered on post and via the Internet. Military personnel stationed on active duty, their dependents, and members of the National Guard are eligible for in-state tuition.

A model partnership between Kansas State University and the military installation was recently renewed. The agreement was designed to serve as a model military-to-university-community partnership. The agreement sets the following objectives: enhancing each institution's ability to accomplish its mission through collaboration; enhancing the professional and personal quality of life for each institution's constituent communities; creating new and innovative opportunities and programs that add great value to each institution through partnership; and increasing capacity at each institution to steward, manage and sustain major resources through collaboration, innovation and partnership.

Kansas State University has numerous programs aimed at understanding and supporting the needs of military personnel as identified in the recent American Council on Education report4. These include:
* The Institute for the Health and Security of Military Families was recently formed at Kansas State University to address the health and well-being of military personnel, veterans and their families "after the battle." The institute coordinates a multidisciplinary group of researchers tackling issues such as the effects of trauma on deployed personnel and family, and the effects of deployment on marriage, children, employment and family income. The institute also provides university students with specialized training on working with military families, conducts comprehensive research on military family issues and provides services to the state and the nation that address the current and future needs of military families.

* Kansas State University has worked with one of the local military installations for nearly 20 years to administer master's and doctoral degree programs in operations research, adult and continuing education, security studies and history. As of spring 2009, these partnership programs have resulted in nearly 600 master's and doctoral degrees, with recently added graduate certificate programs reaching more than 130 additional students.

* The university's office of student financial assistance has a dedicated counselor who specializes in scholarship and financial aid opportunities for members of the military and their dependents. In addition, the university has created a special merit-based scholarship program for college-bound children and spouses of military personnel, and assists with access to other military-specific financial aid opportunities.

* The university offers a Military and Veterans Campus Visit Day for prospective students with military ties to learn firsthand about the resources available to military personnel and their families.

* The university has long had an office at the military installation to provide initial information and enrollment advice for Kansas State University classes. In addition, the university Research and Extension office recently opened an office at the military installation and is set to offer services and programs to military families later this year.

* The university's School of Family Studies and Human Services and the College of Human Ecology also have worked together on several military-related research projects, including one examining the factors families consider when deciding to relocate when their soldiers are transferred to the military installation. This project resulted in several substantive changes at the post to encourage relocation. Another project will study aspects of traumatic brain injuries. Several programs also have been developed for military youth and families.

* The Saunders Barracks at the university's Housing Complex provides housing for ROTC and other military students. These feature one and two bedroom apartments. The building opened in fall 2008.

Today courses and degree programs are offered to military students and their families through distance education, evening college, on-campus and at the military installations. Military students bring a unique depth of experience to the classroom that is appreciated by fellow students and faculty. The university has a Veterans Administration office on campus.
There are many additional support structures that may or may not be available on any given campus. Key supporting components include the development of strategies to inform veterans of engineering workforce opportunities and the recruitment activities, and coordination with campus military veteran support staff and personnel at nearby military installations. Understanding what is available is an important part of the overall success of a program.

Project Success

Student success in the accelerated courses and follow-on courses will be the primary evaluation metric. This evaluation will take place once there are a significant number of students in the program. There are several intermediate outcomes that can be measured as the development process progresses.

The first step will be to evaluate the experiences of interested veterans to determine their preparation for academic study. This will involve evaluating military education and experience for academic credit and/or advanced placement. The comprehensive evaluation of this phase of the program cannot take place until the accelerated programs are in place. However, initial feedback will be gathered from veterans concerning their perceived abilities for success in an accelerated program.

The next step will be the development of recruiting strategies and materials. These materials will include program overviews, workshops, focus groups, and surveys. The effectiveness of these will be evaluated based on feedback from military active-duty and veterans. Evaluation instruments will be developed in concert with the development of the recruiting materials.

The ultimate final evaluation of these programs will be the student retention and degree completion statistics. These statistics can be compared to those of other cohorts using data that has been compiled with NSF support for the last ten years. This database was constructed to provide the ability to analyze retention and graduation rates by freshman cohorts at the university, college, and academic program levels.

Summary

This project is leveraging the training and skill sets of the returning veterans toward fulfilling a workforce need in the area of power engineering. The goals are to provide the academic and non-academic support structures to allow the veterans to be successful in completing their degree requirements. After initial activities within the power area, researchers plan to expand the program into other areas of engineering.

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