AC 2011-2213: T-CUP: TWO + THREE COMMUNITY COLLEGE TO UNIVERSITY PROGRAMS PROJECT: AN INNOVATIVE PILOT MODEL FOR BROADENED PATHWAYS INTO TECHNICAL CAREERS

Patricia F Mead, Norfolk State University

Patricia F. Mead, Ph.D., earned the doctoral degree in Electrical Engineering with a concentration in Electrophysics from University of Maryland, College Park, in 1994. She joined the faculty of Norfolk State University (NSU) as Professor of Optical Engineering in summer 2004. Since her appointment, Dr. Mead has been active in the development of innovative curricula for Optical Engineering courses, and she serves as Education Director for the NSF funded Nano- and Bio-Inspired Materials and Devices Center for Research Excellence in Science and Technology (CREST). Dr. Mead also maintains an active laboratory group that develops laser systems for optical sensing and LIDAR applications. Dr. Mead has previously served as Senior Program Officer at the National Academy of Engineering and served as study director for the pivotal report, Engineering of 2020: Visions of Engineering in the New Century.

Dr. Gwen Lee-Thomas, Quality Measures, LLC

Gwen Lee-Thomas has been an external consultant for over 12 years serving businesses as well as private and public colleges and universities in the state of Washington, California, Florida, Indiana, Illinois, Nebraska and Virginia in diversity, STEM education, organizational culture, and leadership strategies. Gwen has conducted over 30 workshops and presentations on cultural, racial, and generational diversity; assessment, evaluation, and accreditation; teaching and learning; and leadership.

Gwen teaches organization administration and culture, internship experiences, multicultural university, project management capstone course, and strategic planning and institutional effectiveness at Old Dominion University in the graduate program of the Darden College of Education. Prior to ODU, she was the Executive Assistant to the President from 2004 2005 and Director of Assessment from 1998 through 2004 at Rose-Hulman Institute of Technologya small private STEM college in Indiana. She has also served as an editorial associate of a literary journal and office manager of a multi-million dollar construction company. Additional teaching experiences have included Career Switchers of the U.S. Department of Education and The Diversity Instituteboth of which are housed at Old Dominion University.

Gwen's leadership service has included State Board Chair of the Indiana Minority Health Coalitionwhich is a legislated grassroots organization that provides education, advocacy, and research to eliminate health disparities among minority populations in the state of Indiana; and Commissioner on the Indiana Commission for Higher Education appointed by the late Governor Frank O'Bannon. Other service has included, serving on the community relations board for the U.S. Penitentiary of Federal Bureau of Prisons, the United Way Grants Sub-Committee of Vigo County, and Academic Business Council of the Greater Terre Haute Chamber of Commerce in Indiana.

Dr. Abe Eftekhari, Northern Virginia Community College

Abe Eftekhari

Ph.D. in Mathematical Science, University of Texas M.S. in Nuclear Engineering, MIT

Abe Eftekhari has is presently the Dean for Mathematics, Science & Engineering at NVCC [since July 2007]. He is also a Environmental/Energy consultant with Picket Consulting and On-Location. He served as the Chairperson of the Computer Science and Information Technology Department of Southeastern University [1998 -2007]. Before joining SEU, he was the Chief Scientist responsible for Research and Development Programs at Mnemonic Systems [FBI pattern recognition contracts] in Washington, DC. [1996 -1998]. He has worked as a Research Scientist at the NASA Langley Research Center while teaching at Hampton University as a full professor [1989 -1996]. Principal Engineer at Reuters Information Service in Long Island [1987-1988]. Bio-mathematician at the Cornell University Medical College [1985-1987]. Postdoc./Physics Lecturer at UTA [1982 1985.] Manager of the training department at Bell Operation Corporation -Textron in Hurst, Texas [1978-1980].

Abe Eftekhari is also an adjunct member of the faculties of Johns Hopkins University, George Mason University, George Washington University, and the Maryland University. His previous teaching positions were with Hampton University, Dowling College, Tarrent County Junior College, and the University of Texas at Arlington.

Abe Eftekhari has been recipient of several research grants from NSF, NASA, Space Grant Consortium, and NIH. In recent years he has been the Principal Investigator of three research grants in data-mining, satellite communication and Web-enabled Intelligent Tutoring System. Abe Eftekhari publishes in Physics and Material Science Journals under the subject of "Positron Annihilation Spectroscopy and Micro/Nano-structural Characteristics of Material". He has patented 5 inventions, including a table-top low-energy positron accelerator apparatus.

Dr. Ji Hyon Mun, Thomas Nelson Community College

T-CUP: Two + Three Community College to University Programs Project

Background

For more than a decade, consensus-style national reports have called for more effective use of the community college campus as a strategy for realizing broader participation of diverse populations in engineering and other technical careers.[1, 4, 5, 6, 9] The attention that has been directed toward community college pathways is motivated by several attractive qualities that these campuses offer. First, community college faculty are experienced in remediation, an increasingly important issue for all engineering schools in the U.S. They are well positioned in this regard to participate in workforce transitions, (e.g., second careers), or returning to school after extended periods of time. Second, community college tuition is more affordable than tuition fees at four-year campuses; hence, community colleges offer a practical alternative for financially sensitive students and their families. Third, community colleges typically offer greater flexibility in course scheduling, often catering to the needs of part-time students (e.g. working students).

Cumulatively, the above factors outline a compelling argument to look to community colleges to broaden participation in engineering and other technical careers. Accordingly, Norfolk State University (NSU) has outlined a curriculum leading to the Bachelor (BS) and Master of Science (MS) in Engineering degree in three years beyond the Associate of Science in Engineering (ASE) degree. The Two Plus Three Community College to University Programs (TT-CCUP or T-CUP) project was launched in fall 2010 by NSU and four collaborating two-year institutions: Central Virginia Community College (CVCC), College of Southern Maryland (CSM), Northern Virginia Community College, Thomas Nelson Community College (TNCC), and Tidewater Community College (TCC). Student participants in the T-CUP program complete the can earn the BS and MS degrees in Electronics Engineering (EEN) or Optical Engineering (OEN) after completing the ASE from a partner campus. Given the current national imperative to increase enrollment and completion of graduate engineering degrees, the ability to earn the MS within three years beyond the ASE is viewed as an important feature of T-CUP. However, T-CUP also features a number of additional structures to support student retention and success. The 2010 academic year has been used as a planning year, and this paper outlines the salient program features upon which T-CUP has been developed.

Objectives

T-CUP is motivated by two important objectives for which the community college pathway is particularly attractive. First, our program features a practical curriculum leading to a graduate degree in engineering over a five-year period. This alignment with the increasing emphasis on advanced degrees by employers is expected to be an important motivation for students that seek economic stability and mobility in their professional careers. Being able to complete these educational objectives using the community college pathway is further seen as a plus because of the adaptability that community colleges demonstrate for its students.[5, 6]

A secondary objective of this project is to enhance pathways that effectively leverage the post 9-11 GI-Bill, including a focus on increasing the participation of underrepresented groups in engineering careers.[2, 3, 10] NSU, TNCC, and TCC are located in the Hampton Roads region of the Commonwealth of Virginia. With more than 120,000 active military personnel, and over 15,000 annually leaving active duty, Hampton Roads is home to the highest combined concentration of military personnel in the U.S.[8] Four of the five T-CUP partner schools have been designated Military Friendly by G.I. Jobs administrators. This designation is based on the educational value and the support services available to military personnel.[8] Finally, the lead institution for the team, Norfolk State University, is a Historically Black College or University (HBCU) and has a campus enrollment that exceeds 85% African American. Within the Engineering Department, about 90% of the enrolled students are of African American descent.

Program Threads

T-CUP features five program threads: curricular coherence; advising, mentoring, and support services; academic enrichment; networking and community; and assessment and evaluation. The program threads are intended to create a stable infrastructure upon which student success and institutional sustainability can be realized.

Curricular Coherence:

The attractiveness and effectiveness of T-CUP depends in large part upon alignment between the NSU lower-division curriculum and the programs offered by the community college partners. Curricular alignment is determined by factors such as articulation efficiency, transfer of credit policies, and effective use of distance learning and course scheduling strategies. Higher education policies within the Commonwealth of Virginia have aided the approval of university- and program-level articulation agreements. The faculty worked diligently to also establish agreements with College of Southern Maryland. Published documents outlining specific course schedules for all community college partners are available on the T-CUP website, and in hard copy through engineering program officers at the partner schools. The ease of availability of these documents is expected to minimize confusion for students and advisors as they complete registration each semester.

Since the team has identified military personnel as a primary audience for T-CUP, strategies that leverage practical military training and to facilitate highly personalized academic experiences have been examined. As an example, special attention has been given to the American Council on Education (ACE) Guide to Evaluation of Educational Experiences in the Armed Forces.[11] This ACE publication is a standard reference that can be used to obtain recommended transfer equivalents between standard military training activities and formal college courses. This existing information base on credit transfer serves as a practical guide as educators determine potential course equivalents for veterans based on their military experiences.

Preliminary reviews of the NSU OEN and EEN programs identified selected second year courses for which synchronous distance education offerings would be beneficial. For Optical Engineering track students, the sophomore year sequence in geometrical and physical optics will be offered by televideo beginning in fall 2011. NSU is one of only five ABET accredited Optical

Engineering programs in the U.S. A few of the courses that distinguish OEN from most Electrical Engineering or Applied Physics programs occur in the lower-division. Since very few two- or four-year programs offer similarly structured courses, the geometric and physical optics sequence is ideal for the televideo option. The only other required lower-division NSU course that is being considered for televideo delivery is the sophomore level materials science course.

Networking and Community Building:

The networking and relationship building component is intended to strengthen and/or establish connections to the stakeholder military and business communities, and it will increase visibility of the partner programs with a targeted community of high schools participating in *FIRST* (For Inspiration and Recognition of Science and Technology) robotics programs. To begin, the team has leveraged the extensive connections of Veteran's Affairs offices at the partner campuses. Veteran's Affairs typically serves as a connection between the college campus and the military branches, as well as to provide support services for enrolled military personnel. In the Hampton Roads area, it is often found that the Veterans Affairs office will have dedicated office space at each of the Hampton Roads area military facilities. This is the case for the Hampton Roads area T-CUP partner schools. The T-CUP faculty have established an on-going dialogue with the Veterans Affairs staff at each campus. The faculty have used this dialogue to promote the T-CUP website (www.nsu.edu/TCUP), to share and disseminate brochures and proposed newsletter, and to identify potential T-CUP program recruits. In addition to the Veterans Affairs staff, T-CUP also maintains a connection with Hampton Roads area business consortia, and the military-based Educational Services Officer (ESO) community.

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Targeted outreach to high school students that participate in *FIRST* robotics activities will also be conducted by the T-CUP team. FIRST has hosted competitive robotics tournaments since 1992. Founded in 1989 by National Academy of Engineering member and successful inventor, Dean Kamen, *FIRST* currently reaches more than 240,000 students annually[12]. Three T-CUP partner schools hosted FIRST tournaments during the 2010-2011 academic year. NSU, NOVA, and CSM each hosted *FIRST* Tech Challenge (FTC) events this past year, and each is expected to continue hosting these events over the next several years. NSU awards *FIRST* Scholarships sponsored by BAE Systems to two entering engineering students annually. The T-CUP team will take advantage of this exposure within the *FIRST* community by hosting informational booths at the FTC tournaments, as well as additional regional events in Richmond, VA, Washington, DC, and Baltimore, MD. T-CUP will also encourage participating students to serve as tournament volunteers for the tournaments, and T-CUP will explore opportunities to support existing robotics clubs at the NSU and TCC campuses.

As highlighted above, informational materials, including brochures, flyers, and sheets that outline curricula for each community college partnership, have been produced. The project team will also conduct a communications campaign through dissemination of an electronic newsletter. The proposed T-Leaf Newsletter will be available from the T-CUP website. It will feature current and recent events related to T-CUP or the T-CUP student interests, a Brew-Crew Spotlight that highlights the accomplishments of a participating T-CUP student, and a word-puzzle that features themes of interest to students in optics or electronics. The first T-Leaf issue will be available in April 2011.

In addition to the above outlined networking activities, T-CUP will adopt a number of strategies to encourage a cohesive community among student and faculty participants across the five partner campuses. First, officially participating T-CUP students who have indicated their intention to complete a recommended curriculum to transfer to NSU and who maintain a minimum grade point average will be deemed T-CUP Scholars. Second, T-CUP paraphernalia has been procured with an adopted logo and the school initials of all five T-CUP schools. T-CUP Scholars will receive a T-CUP shirt and an embossed notebook for their personal use. A limited number of student privileges will be available to T-CUP Scholars prior to their enrollment at Norfolk State University. These so-called "passport privileges" include use of student recreational facilities, student tickets to athletic events, and NSU library privileges. The passport privileges offer an early opportunity to develop a social connection to the NSU campus.

An annual T-CUP Round-Up event brings current and potential T-CUP students from each partner campus to a two-day open-house of the NSU Engineering Department. The Round-Up includes specially assigned peer guides, tours of the research and other NSU laboratory facilities, luncheon with Engineering Department faculty, and a closed students-only dinner with Engineering Department students. The social activities include a night-event such as bowling or laser tag, an optional bus tour around the city of Norfolk, and attendance at an NSU athletic event. The first Round-Up is scheduled for fall 2011.

Advising, Mentoring, and Support:

Dedicated faculty and staff personnel assist in the completion of administrative paperwork and other student requirements for T-CUP participants. A graduate assistant is also available to assist T-CUP Scholars and other applicants as they complete applications and other requirements associated with successful transfer to the NSU Engineering programs. Where possible, the team will develop helpful templates to proactively inform students of responsibilities and timelines.

Peer mentors supported through the NSF supported Science and Technology Academicians on the Road to Success (STARS) Plus program helps NSU students manage their transition to college. T-CUP leverages this activity by sponsoring a small number of STARS trained student mentors for the T-CUP Scholars. A peer mentor will be assigned to each T-CUP participant upon their arrival at the NSU campus. The peer mentors will likely be engineering students in their senior year of the undergraduate curriculum. The mentors will provide personalized guidance to the T-CUP Scholars, and they will be liaisons to the faculty team. The T-CUP mentors will also serve a small number of hours per week in a tutoring capacity. A systematic procedure for matching the mentors will be developed based on factors such as personal interests and career objectives (as expressed by the T-CUP Scholars and mentors). T-CUP Scholars may be eligible to serve as peer mentors in their second academic year at the NSU campus, but actual selection of mentors will be based on an application process.

Academic Enrichment:

The academic enrichment component features tutoring, including funded student tutors at all partner campuses, and web-based courses and supplements (as recommended by engineering program faculty). These program features have been cited above.

In addition to conventional academic support, the T-CUP team will seek partnerships with business sponsors and government and university research centers to provide summer internship opportunities for T-CUP Scholars. The internships will occur in the summer between the junior and senior year of the undergraduate experience.

Assessment and Evaluation:

The T-CUP assessment plan has a three-fold purpose. The plan will support our research and design effort by gathering critical data needed to achieve and maintain effective marketing strategies and materials. Second, the assessment plan will support continuous improvement by gathering formative input on specific program components and activities. Third, our assessment will yield summative information so that an evidential basis can be established for our evaluation effort. The primary instruments in our assessment effort includes focus group interviews, survey instruments for specific events, and tracking information for participating students.

A table summarizing the performance metrics upon which T-CUP program evaluation will be done is shown below. The table reveals a focus on the impact of T-CUP at NSU. This is due to limited available resources. If additional resources are secured, the assessment program will be expanded in ways that will help measure the impact of T-CUP on the partnering two-year programs.

Expected Program Outcomes

Given the fact that year-one of the T-CUP program has been dedicated to program development and planning, the results to date are limited. However, preliminary performance targets have been developed and are presented here. The team will work to achieve 4-6 transfers to the NSU engineering programs in year one of the project, and 10 -12 engineering program transfers in year two. We also have a goal of gaining 3-5 military applicants to each community college program for fall 2011 admission. The community college partners are expected to identify 7-10 current students from their respective campuses who will be invited to the inaugural weekend Round-Up in fall 2011. Detailed performance targets for subsequent years of the project will be generated annually.

The project team will solicit multiple government agencies, industry, private foundations, and private individuals (scholarships, internships, FTC tourney support, social events, annual dinner events) throughout the project term. The team has accepted the charge to secure 100% funding to support the annual FTC tournament at NSU beginning in 2012, scholarships for non-military T-CUP scholars (including graduate assistantships), and commitments for preferential selection for internships. Some success has already been achieved. The NSU Center for Nano- and Bio-Inspired Materials and Devices will explore special summer internship opportunities, and proposals to the NASA Langley Research Center in Hampton, VA and NASA Goddard Space Flight Center have requested summer internship slots as well. A National Science Foundation S-

STEM grant was awarded in January 2011. This award will support fifty-three scholarships across the five T-CUP partner campuses over the next four academic years. The long-term plan also includes significant institutional support from NSU, including a dedicated staff person with office space to manage and oversee the program long term, faculty release for program advisors (based on achievement of specific enrollment goals), and continuation of preferential course registration.

Table 1. T-CUP Program Performance Metrics

Focus	Metric	Framing Questions
Student Performance	Progression through the curriculum	Are the students on track? Time to degree completion. Identify any challenges or additional support needed. Monitor this by campus.
	GPA	Tracking by semester
	Internship Opportunities and Employment	Number of opportunities? Where are they? Did they lead to employment?
	Scholarship Support Level	Student reported scholarship support
Program-Level Performance	T-CUP Website Statistics	How many hits? From where did they reach the website? How long did they stay on the site? What was searched?
	T-CUP Application Statistics	How many applicants? Where did they learn about – CUP? Acceptance rate? Pre-program credentials and applicant demographics?
	Participation in FTC & Weekend Roundup	How many T-CUP volunteers? Information booth inquiries?
	Industry Sponsorships	Who? How Many? Level/type of sponsorship? Are "new" sponsors being attracted to the program.
	Total T-CUP Revenue	Effectiveness of fundraising campaigns? Portfolio balance (government, industry, foundation, other); Number of scholarships; Number of sponsorships for FTC tournament;
	Institutional Impact	Changes in NSU Engineering program enrollment (total, veteran, and *FIRST* alumni enrollment)
		Number of online courses and course modules offered. Off-site enrollment.
	Student evaluation of program features	Effectiveness of marketing, advising, mentoring, seminar series, veterans affairs activities, etc…

Conclusion

The Two Plus Three Community College to University Programs project has been launched through a coalition of five post-secondary institutions. The T-CUP project features a curriculum

leading to the BS and MS degrees in Optical and Electronics Engineering in three years beyond the Associate of Science in Engineering degree. T-CUP is an innovative twist on popular two – three dual degree programs that bridge science students (e.g. physics or math students) into engineering programs. The T-CUP project has two primary audiences, including military veterans attending college on the Post 9-11 G.I. Bill, and high school students for which community college programs are attractive. The lead institution is Norfolk State University, an Historically Black University, and T-CUP is seen as a program that will be attractive program for underrepresented students and their parents. A comprehensive evaluation effort will document how well the T-CUP team successfully achieves its intended goals and objectives. The project team believes the T-CUP project may potentially serve as a national model for engaging broader audiences in engineering careers. T-CUP is a National Science Foundation funded project.

Bibliography

1. Adelman, C. (1998). *Men and Women of the Engineering Path: A Model for Analyses of Undergraduate Careers.* Jessup, MD: U.S. Department of Education.
2. Finken, D. A. (2004, November 4). Community Colleges Vital for Diverse Engineering Workforce. *Black Issues in Higher Education* .
3. Montgomery College. (n.d.). *Combat2Campus: Facilitating College Success for Combat Veterans.* Retrieved August 26, 2009, from Montgomery College: http://www.montgomerycollege.edu/combat2college/Combat2College-article.pdf
4. National Academy of Engineering. (2004). *Engineer of 2020: Visions of Engineering in the New Century.* Washington: National Academies Press.
5. National Academy of Engineering. (2006). *Enhancing the Community College Pathway Into Engineering Careers.* Washington: National Academies Press.
6. National Academy of Sciences. (2007). *Above the Rising Storm: Enrgizing and Employing America For a Brighter Economic Future.* Washington: National Academies Press.
7. Pavelek, M. (2009, August 17). Military Friendly Schools List Released. *G.I. Jobs* .
8. Roberts, F. (2009, August 18). Executive Director, Hampton Roads Military and Federal Facilities Alliance. (P. F. Mead, Interviewer)
9. U.S. Department of Education. (2007). *A Test of Leadership: Charting the Future of U.S. Higher Education.* Washington: U.S. Government Printing Office.
10. U.S. Department of Veterans Affairs. (2009, April). Workshop on GI-Bill in Engineering and Science Enhancement Program. *The Post 9/11 GI-Bill: An Overview* . McClean, VA.
11. American Council on Education (2009).Guide to Evaluation of Educational Experiences in the Armed Forces.
12. Viewable online: www.usfirst.org/aboutus. March 11, 2011.