AC 2010-2061: FINDING EFFECTIVE PATHWAYS FOR RECRUITMENT INTO ENGINEERING TECHNOLOGY PROGRAM

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Finding Effective Pathways for Recruitment into Engineering Technology Program

Abstract:

In order to capitalize on the technologists' potential to enhance global competitiveness, new strategies must be devised to encourage high schools, community colleges, and some other nontraditional pools to seek engineering technology degrees. This type of proactive philosophy will undoubtedly increase the number of much needed technologists in this country. Community colleges have traditionally done an exceptional job of preparing technicians for industry. But, graduates of AAS programs experience more difficulties in securing transfer credit than their Associate of Arts (AA) degree counterparts. From the high school point of view, they have been less than successful in transitioning their students in STEM pathways. We feel that a three tiered collaborative effort is needed between Universities, Community Colleges and High Schools to have a reasonable chance to increase the pool of candidates into engineering technology programs. At our institution, we have a great deal of experience in articulating with two-year programs and looking to expand similar relationships with regional high schools. With two-year the problem lies in the inherent difficulty of determining university course equivalency for AAS technical courses; a dilemma not characteristic of AAS transfer initiatives. When transferring to a four-year program, direct equivalency is not always possible due to regulatory requirements; but in an outcome-based culture, it should be possible to create supplementary modules that make such transfers feasible. With high schools we have identified the absence of pathways that channel STEM-inclined students into programs including engineering technology. The objective of this paper is to document the need for four-year institutions to participate in creating pathways that lead students both from high schools and community colleges into engineering technology programs. We are going to be looking at perspectives from high school counselors and teachers, community college technology program directors, career services liaison, four-year administration and faculty. We will present our collected results using survey data and narrative on the collective insight from all three constituent stakeholders.

Introduction:

While engineering technology programs have definite differences with engineering programs, the fact does not get easily recognized for various reasons including the fact that there are fewer engineering technology programs when compared to their better known cousins, the engineering programs. Engineering technology programs tend to get lumped together with either engineers or with technicians. The Department of Labor in reacting to a petition for a separate category for the "engineering technologist" has supported the previous point of view in responding to a petition and stating the following, *"The job title "engineering technologist" is used by workers who are classified in 17-2000 Engineers and by workers who are classified in 17-3000 Drafters, Engineering Technicians, and Mapping Technicians. The title is more appropriately used to identify educational background rather than occupational duties, and the duties performed by Engineering Technologists vary widely[1]."*

To add to this confusion, "engineering" is by itself a porous discipline where many engineering graduates go on to non-engineering professions, while others without such degrees actually function as engineers. Our initial survey of local high schools and regional two-year college, faculty and administrators, seem indicate a lack of understanding for both engineering and engineering technology programs. For those who rated their understanding of careers to be average or less than average, the number was 69% for engineering technology careers, 65% for engineering careers, and 50% for Math/Science careers (these results of the survey support the analysis of a Massachusetts study where the understanding of Math/Science careers fared the best [2]). With all this in the background, the author's have concluded that a true understanding of engineering technology programs requires that it be studied it in comparative terms with other Science, Technology, Engineering, and Mathematics (STEM) programs. Therefore, our goal of finding effective pathways for recruitment into engineering technology programs is well-served by the development of a STEM pathway.

In this endeavor, the principal partners would consist of an engineering technology department and a school district in its vicinity. The first step in this effort would be to help facilitate a STEM pathway which assists students in making informed career choices. Faculty from an affiliated engineering program will join four-year math/science instructors to assist the principal partners in creating a concurrent credit course that provides students with an inside look at the rewards and demands of a STEM career through a combination of lectures and hands on experiences. Initial discussions with the school district officials seem to indicate a willingness on their part to facilitate this initiative by making this introductory course a part of their proposed STEM pathway. Qualified high school students will also be able to pick other existing four-year college STEM offerings as concurrent credit or dual credit.

The STEM course (or its adapted form) can be used to facilitate a three-tiered articulation that also involves two-year programs (Fig. 1). With two-year programs, the problem lies in the inherent difficulty of determining university course equivalency for AAS technical courses; a dilemma not characteristic of Associate of Arts (AA) transfer initiatives. When transferring to a four-year program, direct equivalency is not always possible due to regulatory requirements; while our <u>immediate</u> focus is on the STEM course, in an outcome-based culture, it should be possible to create supplementary modules that make such transfers feasible.

The objective of this paper is to document the need for four-year institutions to participate in creating pathways that lead students from high schools and community colleges into engineering technology programs. We are going to be looking at perspectives from high school counselors and teachers, community college technology program directors, career services liaison, four-year administration and faculty. Our collected results are derived from survey data, literature review, and the collective insight from all three constituent stakeholders.

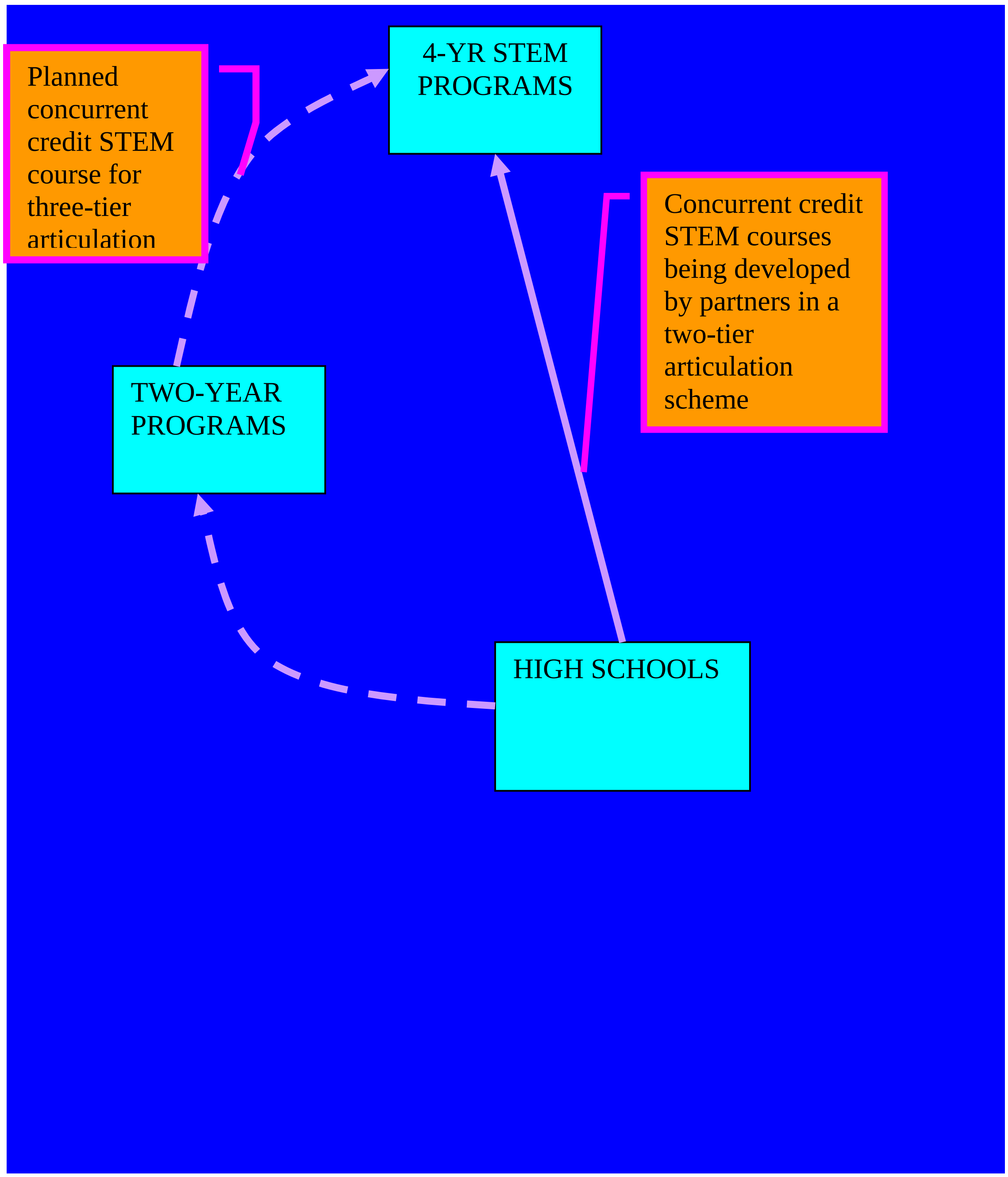

Fig.1. Two- and Three-Tier Articulation and the Scheme

Teaching Roles for the Introductory STEM Course:

In designing the course, the Engineering Technology Department will be taking the lead in gathering the input from all partners and will coordinate between them. As mentioned previously, the goal of this course is to help high school students make informed career choices within the STEM disciplines, and in this effort, who will be teaching is just as important as what is being taught.

An article appearing in the *Bridge* Journal (Published by National Academy of Engineering) documents the difficulties and challenges associated with the introduction of technology/engineering standards,

> *"…the systematic implementation of technology/engineering standards in Massachusetts. Many technology education teachers were resistant to the change, causing a split in the state's technology education organization. One side was aligned more with the industrial arts-technology education perspective; the other with the technology/engineering- academic c perspective. Those who were watching this process, including school science staff, curriculum coordinators, and administrators, saw the unresolved conflict as a reason to delay the incorporation of technology/engineering concepts into school programs*[2]*."*

While there are clear benefits in having high school teachers bring STEM concepts into the classroom[3], the progress has been slow in the incorporation of technology/engineering concepts into schools using K-12 teachers (more than ten years in the case of Massachusetts schools[2]). It is therefore our conclusion, that a speedy and economic solution in facilitating this initiative requires four-year partners to deliver the content after seeking input from all concerned.

Survey Data:

Survey data also seem to support the need for an introductory STEM based on the following observations.

1. 56 percent of respondents rated their overall understanding of STEM careers as being average or below average. This was 50 percent for science and math, 65 percent for engineering, and 69 percent for engineering technology)
2. 65 percent of respondents felt that creating pathways was very important or extremely important for engineering technology recruitment.
3. 52 percent of respondents thought that articulation between high schools and four-year schools was either important or very important form of STEM articulation.
4. 58 percent of respondents thought that 3-tier articulation between high schools, two-year schools and four-year schools was either important or very important form of STEM articulation.

The survey data also provides insights into educator thinking in other areas e.g. the importance of hobbies; the influence of family and friends; etc. Data of this nature will help us with tailoring the curriculum.

An Argument for Inclusion of Soft Skills as a Part of the Course:

As previously stated, a key element of the proposed course is to help students understand their career options within STEM fields. However, there are some increasingly important soft skill components that cannot be ignored in this process. It is also important that students to see the importance of soft skills in STEM disciplines. The following sections discussion centers on such skills:

Globalization and Global Skills: Graduates of STEM fields with an interest in developing global skills are very marketable in this economy. In an era marked by rapid globalization, the need to train and maintain a technological workforce capable of meeting the challenges of managing America's resources at home, and abroad, remains a key priority[4-8]. As an example, Engineering technology[9, 10] students who possess global skills are well suited for the global world, they have the required combination of theory and hands on skills that make them ideal for technically overseeing the product development cycles which involve partners abroad.

In teaching about globalization, it is also important to allay the fears associated with global competition in the STEM areas. Fears that are documented in a "finding" by the Committee on the Offshoring of Engineering setup by National Academy of Engineers (NAE) reads,

> ***"FINDING 6.*** *Over the past several decades, engineering has become less attractive to U.S. students as a field of study and as a career compared to some other professions. Although it is widely assumed that globalization and offshoring are contributing to this relative decline in popularity, it is impossible to know how important globalization is compared to other factors. A great deal more needs to be understood about the relationship between offshoring and the attractiveness of engineering as a career[11]".*

The need for engineers and technologists will continue to be strong despite as "wage disadvantages" faced by US companies as a result of globalization will be overcome by the need to satisfy regulatory requirements, national security concerns, and a higher caliber of training in US schools[10].

Teamwork: Nothing today is accomplished without teamwork in a global, national, or local context. The Accreditation Board for Engineering and Technology (ABET) requires teamwork skills be a required Student Learning Outcome for both engineering and engineering technology majors[12, 13]. Importance of teamwork is such that we believe it should permeate the entire course and students should be required to team up in their projects and other activities.

Other Soft Skills: There are other soft skills like technical writing and project management that getting left out due to time constraints.

Course Objectives:

Based on our discussion thus far we feel that the following course objectives should be met by this course.

a. The ability to distinguish between STEM fields and careers.
b. Ability to theory learned in a hands-on STEM activity in the Science Area using tools of the profession.
c. Ability to theory learned in a hands-on STEM activity in the Technology Area using tools of the profession.
d. Ability to theory learned in a hands-on STEM activity in the Engineering Area using tools of the profession.
e. Ability to theory learned in a hands-on STEM activity in the Mathematics Area using tools of the profession.
f. Understand the importance of global skills and globalization.
g. Understand the importance of teamwork.

Structure and Format of Course:

The course will consist of face-to-face lectures and laboratory exercises. Critical portions of the lecture will be taped and placed online for students to view. All topics will be accompanied by assignments. With the exception of the first lecture, students will be assigned reading online assignments prior to the class. Homework will be assigned in every class expect the last.

Table 1 (next page) shows a tentative schedule for the entire course with a list of objectives being covered in each topic. All course objectives will be assessed through exams and other assignments. The schedule also shows that technology and engineering topics tend to more coverage in the course; this is a deliberate move makes sense when you consider the current system does a better job of preparing students for science and math careers, this is supported by our survey results discussed earlier.

Topic	Wk. #	TABLE 1. TENTATIVE SCHEDULE FOR COURSE	Course Objective covered
Course Introduction	1	Introduction STEM careers: Broad Differences, Rewards and Demands. Online Technology used in the Class	a
Science	2	Intro to Chemistry Careers An activity that involves application of basic chemical principles	b
Science	3	Intro to Physics Careers An activity that involves application of basic physical principles	b
Technology	4	Intro to Electronic and Computer Engineering Technology Careers An activity that involves application of basic digital/electronic principles	c
Engineering	5	Intro to Electrical and Computer Engineering Careers An activity yet to be determined	d
Technology	6	Intro to Mechanical Engineering Technology Careers An activity that involves application of basic mechanical principles	c
Engineering	7	Intro to Mechanical Engineering Careers An activity yet to be determined	d
Technology	8	Intro to Computer Systems Technology Careers An activity that involves application of basic computer system principles	c
Engineering	9	Intro to Chemical Engineering Careers An activity yet to be determined	d
Technology	10	Intro to Construction Engineering Technology Careers An activity that involves application of basic construction principles	c
Engineering	11	Intro to Civil Engineering Careers An activity yet to be determined	d
Mathematics	12	Intro to Careers in Mathematics A software activity using basic math principles	e
Soft Career Skills	13	Global Skills and Globalization	f
Soft Career Skills	14	Teamwork Topics	g
Soft Career Skills	15	Review and Teacher Evaluation	a thru g
	16	Final Exam	a thru g

Concluding Comments (Kindling Student Interest in STEM Careers):

As students ponder four-year plans of study each school year as they choose classes for the coming year, counselors encourage them to consider their future plans. Some have no problem looking forward, others struggle year after year. High school students are encouraged to choose state and school designed career pathways to help provide some direction. However, it is important to remember that the pathways that are selected at times represent well thought out plans and other times are little more than a random choice made because the student wanted to get on to another task or their best friend told them to pick a certain path.

While the survey shows that adults think that parents, teachers, and counselors are important in the decision-making process, practice in the high school classroom tells us that friends, whims, and gossip are often more important in making course or pathway decisions. Most students can identify the "cool" courses, the "easy" classes, the "good" teacher, or the "tough" one. What tends to be important to students is that they take the classes they "have to take" to graduate and for college-bound students the ones they need to score better on the ACT or that are required for college entrance.

With these types of factors in play, how can we hope to create student interest in STEM courses with any hope that they will show some interest in engineering technology? The Kansas State Department of Education has helped to some degree by increasing math and science graduation requirements several years ago. Students are now required to complete three years of math and three years of science to graduate from Kansas accredited high schools. Taking a fourth year of math and science has been included as a recommendation/requirement for completion of some high school pathways.

Even with these in place, most students and parents would be hard pressed to name careers that students might pursue if they completed a degree in engineering technology. Using some of the previous information, what could be expected to happen if a high school class could be offered that was "hands-on" and students did "cool" stuff? What if it could count as a science credit?

While the details have not been fully worked out, the plans are proceeding to offer a concurrent high school course where students would be "exposed" to various technology disciplines with the hope that some of them might catch the technology bug. The course would not only provide the math/science/technology/ tie-in but would also allow high school students to see firsthand what engineering technologists do and the job possibilities that may be available. As an added bonus, those involved will tell their friends, and maybe even their parents, the things that they have been doing, thus perpetuating the interest.

Many students will not go outside their realm of experience to make career choices. This type of class can bring technology into their experience and help them decide if this is a path they would like to follow where before they didn't know a path existed.

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