REVISION OF THE FMCC Electrical Technology (ET) PROGRAM

The importance of computer/software knowledge has progressively increased. Severely limited two-year curriculum time must be managed well to provide students minimal but sufficient experience with embedded controllers, interfacing and software. Changes to the FMCC ET program will involve creating product-based learning modules and new interactive learning environments. Changes also will affect the existing FMCC one-year Electronics Certificate program, which has been an entry point to technical training for displaced workers. FMCC expects to enroll 20 students in the two-year ET program and one-year Electronics Certificate program for each of the three years of the project.

Richard Prestopnik, (PI for TEPP) ET Professor at FMCC, has been actively involved in several ATE projects. He began updating his ET courses before and continued after Frenzel Jr.'s landmark article[6]. FMCC sees this proposal as an opportunity to complete the transition of ET courses to a mixture of cutting edge instructional content and instructional style that will match the needs of the workplace.

At the **community college** level, TEPP's intent is to educate students to become technicians in the electrical/electronics industry – electronics, clean room, and customer service technicians. The STEM Vertical Alignment Model will describe reformulation of the existing specialized core courses of FMCC's A.A.S. ET program. The eight ET curricular product modules to be developed will be key to completing transformation of the FMCC ET program from what was a traditional program a decade ago, to a cohesive, contemporary workplace-driven, systems-based program. The model will provide direction for changing other FMCC A.A.S. programs (see Insert 2) following completion of the three-year ATE funding period.

Insert 2, List of FMCC Programs Relevant to TEPP

The two-year Associate in Applied Science (AAS), transfer oriented two-year Associate in Science (AS), and one year certificate programs are available to students at FMCC:

Electrical Technology (AAS); Electronics (Cert); Computer Technology (AAS); Engineering Science (AS); Computer Information Systems (AAS); Computer Systems Specialist (Cert); Computer Science (AS); Multimedia Technology (AAS); Multimedia Technology (Cert); Construction Technology (AAS); Automotive Technology (AAS).

When the TEPP management team originally researched prior ATE projects, the team was concerned that the project: Developing a Model for Agriculture, Information Technology, and Electronics Technician Education in Rural Communities (DUE-**0501876**) appeared to emphasize electronics and therefore TEPP might be repeating what that project chose to do. But, after speaking with John Blaylock, the PI of the project, and visiting the project's website (www.tann.nebraska.org), it became clear that there was not overlap, that the curricular materials developed were digital web and image program oriented and not heavily focused on electronics.

The project management team visualizes development of the community college component of TEPP progressing in this way:

Product Module Presentation – The product modules will be designed to stand alone. The development process will explore unique instructional delivery methods to take place in an interactive learning environment using advanced projection equipment. Presentation of the FMCC product modules will be enhanced by newer technologies such as touch-sensitive projection technology, and Microsoft Surface. Special features of the ET product modules will be

adopted and adapted from an ATE project, the *Maricopa Advanced Technology Education Center* (MATEC, DUE-07027530.) MATEC has developed an industry-supported system for synchronizing curriculum to the rapidly changing workplace using the most recent electronic methods, circuits, systems, and practices in simulations and virtual labs. MATEC's programs, materials, and training methods enable students, faculty, and technicians to continuously master STEM workforce competencies for the semiconductor, electronics, and advanced manufacturing industries. Current enrollment data from three partner colleges implementing the new MATEC electronic systems-oriented curriculum show enrollments increased over 50% in the two schools having previously existing electronics courses, and excellent retention data at all three schools.

TEPP product modules will emphasize laboratory activities. Many will take place through a learning environment shaped by Microsoft's Surface technology and other touch-sensitive projection technologies. Surface computing products have been shown to break down traditional barriers between people and technology. An ordinary tabletop turns into a surface that provides interaction with digital content. Students surround an interactive table in the classroom and interaction occurs through natural gestures, touch, and the proximity of physical objects. Also, product subsystems can be viewed in an "exploded" form permitting individual components and functions to be explored comparatively. Students can use the table surface for instructional animations and simulations, or for "what if" scenarios that reveal how circuits respond to the manipulation of variables. Specialized multimedia items will become part of the product modules, and will be used together with "off the shelf" simulation products.

The adoption of electronic and traditional writing surfaces creates an interesting learning environment, provides continuity in the development of long-term student projects, and promotes student interaction as technical ideas are generated and explored. The use of surface technologies adds an additional layer of technology-based interaction to the lives of students and enhances enjoyment whenever simulation products are introduced. Students relate well to the computer technology necessary to run simulation software. The iPhone user interface, which is similar to that of Surface, would seem a compelling motivator for making use of Surface in educational activities.

Product Module Organization - Another ATE project, the *New York State Curriculum for Advanced Technological Education* (NYSCATE, DUE-0053269) will inform the development of the FMCC curricular product modules. NYSCATE modules are defined and organized through "Informed Design Challenges." Knowledge and Skill Builders (KSBs) provide students with "just in time" content and skills as they plan their approach to resolving a problem. This "Research and Investigation" phase requires students to suspend tendencies to begin work immediately in design challenges. Instead, they learn to take time first to inform themselves. Since KSBs are introduced first by TEPP at the high school level, the first cohort will be familiar with the organization of product modules when they begin the new community college coursework.

Product Module Content - While not every consumer product explored in TEPP will have a regional manufacturer, field experiences at manufacturing and technical service companies will become a common event. The intent to use devices such as cameras as a focus for a product module raises the question, "How does one gain sufficient information about cameras to feature them in a product module?" To do so while addressing a criterion of "matching coursework to workplace activities" calls for the faculty taking time to build relationships at regional branches of the companies whose consumer products are to be explored. Field experiences closely matching the technological aspects of the consumer product must be developed; if a camera is to be used as a device of interest in a product module, and a "camera trip'" is not feasible, there might instead be a class visit to a company that uses digital technology similar to that of cameras. In that way, students get to explore similar technologies that are available at local companies. Visits will be preplanned with the target industry/company so that visitations match

components of the NYSCATE Design Cycle, or other relevant topics. A single visit might challenge students to explore design concepts, take part in a simulation, or analyze a manufacturing process. Issues such as time and distance problems will be addressed and resolutions included in the STEM Vertical Alignment Model. The staff at FMCC has had success conducting similar visitations in the past.

Approach to FMCC Curriculum Development - The TEPP management team envisions the desired innovative learning environment being developed by:

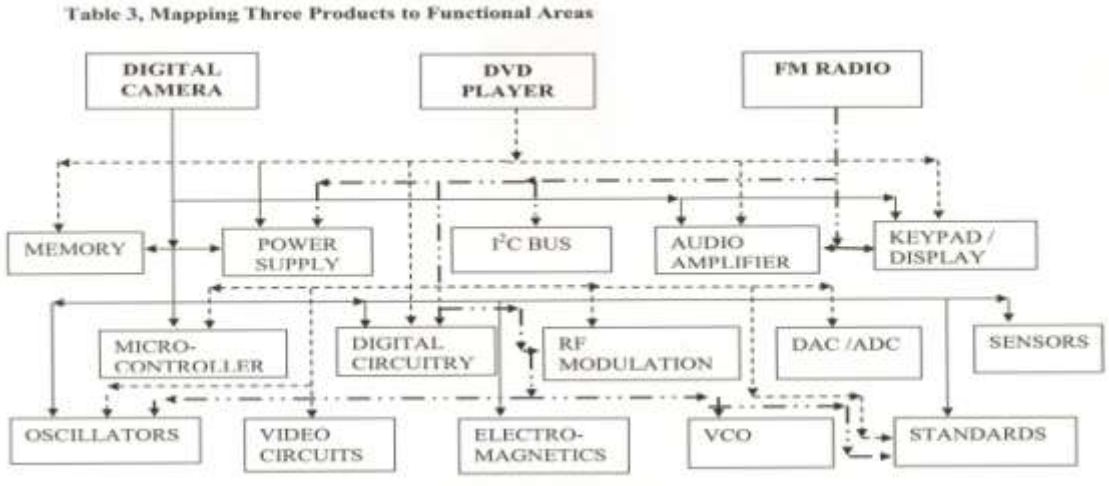
- researching the Microsoft Surface system and/or similar alternatives.
- researching interactive workplace environments.
- developing a facilities plan for the learning environment.
- deploying the facilities plan in phases.
- finding suitable simulation software for Surface/alternatives.
- finding and developing multimedia to run on Surface/alternatives.
- developing effective uses of technology for instruction.

The FMCC curricular product modules will be developed using the following steps:

1. Consumer products will be selected and compared to establish common functional areas. (Possible products include digital cameras, DVD Players, or programmable thermostats.)
2. Common characteristics will be identified for the products related to the electronic topics.
3. Functional areas will be mapped to FMCC ET courses.
4. Information obtained from analysis of a detailed study of the products, functions and course mappings will drive development of the product modules.
5. Product module developers will then choose and develop eight electronics topics such as: power supplies, amplifiers, or microcontrollers.

The curricular product modules will be applicable to and infused into existing courses of the FMCC ET program – Electricity I; Electronics I; Digital Electronics; Introduction to Microprocessors; Fiber Optics/Semiconductor Manufacturing Technology; and Tele-communications. Products selected for development by TEPP will contain components currently treated in existing ET courses; a digital camera containing a microcontroller is explored in both the Digital Electronics and Microprocessors courses; the camera contains electronic subsystems applicable to Electronics I and Electricity I. The image in Insert 3, Mapping Three Products to Functional Areas, represents a simplified rendition of the analyses necessary to map product components to ET courses. This process will be repeated for each product, and a curriculum map will be created to determine which eight product modules are to be developed.

Insert 3, Mapping Three Consumer Products to Functional Areas



A systems-oriented approach to learning leads to analyses of circuitry and electronic systems at a functional level rather than at a more detailed component level. The analysis of circuit response for each discrete component will be de-emphasized, since new products typically use integrated circuits to support product functions. FMCC's ET lab experiences will include product-oriented work to provide college students an innovative teaching/learning environment that features contextualized, problem-based learning. Such opportunities presented in a team-building setting will introduce and reinforce the key engineering and technology concepts that undergird successful careers. Google Corporation, for instance, includes in its buildings whiteboards available for all to use, as inspiration may happen anywhere. The idea is to have students focus on learning through participation. Elements of these interactive environments will be adapted by TEPP for systems-oriented electronics instruction.