Model Online Industrial Technology Programs

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Abstract— **This paper outlines a proposal for serving working professionals in industry by offering them two programs of study to enhance their education and improve their job prospects. The programs were specifically designed to meet the needs of the manufacturing industry in Texas. The courses are proposed to be offered online because we expect working people to be interested in these programs. By offering courses online we can attract a new group of working students that are constrained by their jobs from being able to take regular courses.**

Keywords—Online Programs; Distance Education; Online Education; E-learning; Industrial Technology Programs

I. INTRODUCTION

The objective of this paper is to show the readers two online industrial technology programs, one at the undergraduate level and one at the graduate level that help working adult students take online courses and programs. These programs help working adults continue their education and improve their job prospects.

The problem that these programs solve is offering online courses to working adults so that they can continue their education to improve their job prospects. Many of these working adults cannot attend regular classes at regular working hours because of their job schedule.

The solution included a plan to offer two new courses online every semester. Continuing students can enroll in two new courses every semester for two years until graduation. We tailored the online courses to meet the needs of the working online students based on their input. According to the literature, students enroll in web-based courses for 2 reasons: (1) the class is necessary for completion of a degree, which is the key to improved employment opportunities [1], and (2) the convenience of time-and-space independent distance learning courses [2]. In addition to solving time conflicts, on-line courses provided the convenience of allowing learners to log on and consider the course material whenever they chose [3]. Students, particularly adult learners, embrace online learning because of the convenience of taking courses from home or from work without cost and time issues associated with travel to and from a traditional campus [4]. Distance education removes some of the barriers that keep students from attending higher education which include work, family obligations, lack of time, and lack of self-confidence [5].

II. LITERATURE REVIEW

Historically, distance education has been thought of as a means to deliver instruction between geographically separated people [6]. As new technologies have permeated our society, each presents a new medium for delivering education courseware. Online instruction has advantages over previous forms of distance learning. Online courses offer ease of updating material and delivery [7]. With the use of technology, distance education has managed to grow and survive alongside traditional education. Of the public institutions that offered distance education courses during the 2000-2001 academic year, 90% offered online courses using asynchronous instruction while 43% offered online courses using synchronous instruction [8]. The current, most technologically advanced form of distance education is accomplished via the Internet. With the use of the Internet, computer mediated instruction is available. Four categories of teaching strategies that have adapted well to online instruction include (1) support/facilitation: forum discussions, online debates, Socratic technique, group work, group problem solving, email interaction, chat forums; (2) learning tasks: lecture, tutorial, small group work, simulation, role play, research activities, linking to interactive websites, self quizzes; (3) structures/learner expectations: clear goals and objectives, assignments dated clearly, time frames for completing work; and (4) resources: demonstration movies, storage bank for lectures, case studies, linking to personal stories and case studies, and providing clear notes for easy access [9]. Those strategies that were reported as not effective included: traditional lectures, lots of text on web pages, motivation, personal contact, practical exercises, group work, social environment for learning, practical to theory was reported as much more difficult to accomplish, free ranging class discussion and individualized attention to struggling students [4]. The strategies considered effective had nothing to do with traditional teaching techniques and everything to do with web page design, course ease and accessibility. The strategies considered as less effective were more related to traditional styles of instruction, such as lecture, personal contact and guiding discussions [4]. This information seems to support the theory that instructors are not only changing platforms, but they are changing roles. An on-line course needs to be

carefully designed and managed since it is the only interface students have with an instructor and the content. For example, assignment specifics, expectations, and structure should be clearly defined and managed in on-line courses [10].

Increased interest in distance education and increased enrollment, particularly in online learning, have required university administrators to offer additional courses at a distance, which indicates a need for faculty involvement in distance education. As student enrollment and online course offerings continue to increase, institutions will need faculty who are willing to accept the challenge of teaching online. Adequately preparing faculty for the transition from the traditional setting to the online environment allows instructors to acquire the appropriate skills to provide effective online instruction. Faculty consistently felt that additional instructional and technical support were needed because faculty were genuinely concerned about the quality of their distance education courses and the amount of technical assistance and training available to them at their institutions [11]. Although learners are expected to steer their own learning, instructors are expected to facilitate the process, which makes the use of technologies like chat rooms, email, and discussion boards essential for communication in an online course [12]. When transitioning into the distance environment, faculty are challenged with actually designing and developing their courses to be offered online. The design of an online course is a major element because it allows faculty to plan how appropriate pedagogy and technology will be effectively incorporated into an online course [13]. Training for the actual design of an online course is needed to help prepare faculty, who are sometimes overwhelmed with technology, in the development of instructional skills and strategies that will stimulate successful learning in their courses [14].

Asynchronous Internet-based technologies were cited as the most widely used technology for the instructional delivery of online courses [15]. Because access and flexibility tend to drive more and more students to online learning, it is also important to ensure that these students stay in their online courses and programs. The strategies considered effective have nothing to do with traditional teaching techniques and everything to do with web page design, course ease and accessibility. Many instructors felt that they were under time pressure to create the course material and actually learn the technology needed to adequately instruct and that this inhibited their motivation to initiate a transition or incorporation of online instruction [16]. Those who had taught online felt that they were not rewarded for the extra work and time needed to prepare and execute the online courses. Some felt that they were able to reach a more diverse student population through online instruction. Many enjoyed the flexible working conditions afforded by online instruction. Faculty felt that faculty should be given release time or a stipend to develop classes, they should be directly involved with selection of texts and readings and the creation of the online assignments. The new role of online instructor may prove overwhelming without guidance. Distance-delivered continuing professional development (CPD) is growing at an enormous rate among multiple professions [17].

Factors affect the implementation of successful online courses include policies, funding, student support, technology, curriculum, access, equity, staff development, and administration. Numerous studies and publications indicate a need for the staff development of online teachers to develop high quality instructional programs for students. It is understandable that to undertake a new medium for delivering instruction, teachers need to be provided the necessary training to utilize the new opportunities to ensure student success. Faculty development is the key to increasing student achievement through the improvement of teachers' skills and abilities. A successful faculty development program is cyclic in nature. Other research in higher education indicated the factors leading to student success encompass learning styles, mentoring, course startup procedures, instructional design, ability level of students, and the instructor's role and ability. Factors affecting implementation included funding, technical expertise, legal issues, professional development, policies, and administrative structures. Students were most comfortable when provided advanced course information allowing them to prepare for the course. Schools need continuous assessments to evaluate the online course curriculum, students' success, and implementation policies and procedures. Leading virtual schools provided professional development to staff to assure success. In the SREB publication, *Essential Principles of High-Quality Online Teaching* [18], regarding the evaluation of online teachers it is stated that school districts and states need to make every effort to choose, train, and evaluate online teachers to assure that every student is taught by a highly qualified instructor.

Professional development strategies ranged from extensive online training to extensive face-to-face training, all appearing to be effective [19]. Online teachers must be risk takers, willing to pay attention to detail, and possess a desire to succeed in an alternate form of teaching [20]. As with a traditional teacher, online teachers must still have knowledge of content, ability to plan, and must provide timely feedback to students. Teachers of online courses must receive training in pedagogy, design, and delivery of online courses. The training must be delivered in an online situation where teachers learn by doing. Faculty who are or will be teaching online courses are faced with new issues of learning the technology to create a course online, communicating and distributing the information to the students online, and creating a virtual class community to bring all the students and their ideas together are some of the new roles that faculty have to explore and improve upon when utilizing Internet technology in offering online courses [21]. Online interaction is virtually produced and students need to have available means of

establishing and maintaining connectivity. Many online practitioners have emphasized the importance of the instructor's role as a vehicle of the connectivity in online learning through the creation of a learning community. The role of the instructor is to keep the learning community functional in virtual classes by designing the course to allow participation of all the students as community members and help to increase the participation. The sense of community will help remove the sense of isolation among online students and subsequently help them remain in the class and continue the learning process. The characteristics of a good learning community are suggested as: participants should be regularly involved in discussions, feel comfortable to express their honest opinions, and be supportive [22]. Overall, it seems that there has been little difference in the degree of success for online students when compared with students in traditional learning environments [23] [24]. Many faculty members have transitioned to offering online courses, where much of the emphasis has been on training in the learning management system instead of the design of instruction. The tendency for universities to place courses on the web has often resulted in the focus being placed on information delivery rather than learning [25]. The goal of any instructional system is to promote learning.

In order to persist in their on-line courses, students must be self-directed [26]. A self-directed student exhibits the following characteristics: motivation, self-discipline, and responsibility [26]. The four basic principles of the Characteristics of Adult Learners model were that: (1) adult learning programs should capitalize on the experiences of the adult; (2) they should adapt to the aging limitations of the participants; (3) adults should be challenged to move toward advanced stages of personal development; and (4) adults should have as much choice as possible in the organization and availability of the learning program [27]. Based on principles of adult learning theory and feedback from focus group students, recommendations for the development and teaching of online courses were provided: (1) State clear expectations by providing a detailed syllabus with schedule, grading criteria, assignments, number of postings per week, deadlines and office hours, (2) avoid changing aspects of the course once it begins, (3) state contingency plans for when technology fails, (4) incorporate multiple forms of feedback into the course and (5) use specific, consistent feedback from both learners and instructor [28]. Successful online education is dependent on two-way interaction [29]. Without this interaction, students may feel isolated and begin to procrastinate. Good elements of on-line course design include clear discussion topics, readings, and assignment schedules [30]. They point out that the schedule should be completely predictable. Many studies have found no significant difference between traditional and online learning in terms of grades and achievement [31].

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III. METHOD

Many of our working students are on call and have to work odd and long hours when they are on-duty. This makes attending regular classes difficult, if not impossible. The constraint is overcome by offering new online courses that met the needs of these students and their employers. The students are able to enhance their skills in order to be promotable. Table 1 shows the 120 credit hours required to get a bachelor's degree. Forty-two hours of general education credit are required of all bachelor's degree programs in Texas. Thirty-nine credit hours in the occupational specialty can be transferred from a two-year technical program. Three credit hours in computer science are also required to get a bachelor's degree in Texas.

The thirty hours of professional development are upper level credit hours and are shown in Table 2. The Capstone Project is a course required of all BAAS (Bachelor of Applied Arts and Science) majors. The Internship course helps complete the hundred and twenty hours.

TABLE I. BAAS PROGAM WITH TECHNOLOGY CONCENTRATION

Academic Foundations and Core Curriculum	42 credits
Occupational Specialty	39 credits
Computer Science	3 credits
Professional Development	30 credits
Internship	3 credits
Capstone Project	3 credits
Total	120 credits

IV. RESULTS

A two-year online course rotation cycle was developed for the Technology courses (professional development). It is shown in Table 2. Two new courses were put online in Desire-To-Learn (D2L), our learning management system (LMS), each fall, spring and summer semester until we had all the courses online in the summer of the second year. As per the rotation cycle courses will be taught only once in two years after the cycle is complete. We have completed the first rotation with 25 students in the program and have started on the second rotation in fall 2021.

TABLE II. PROFESSIONAL DEVELOPMENT CYCLE

Course no.	Course title	Yr. 1	Yr. 1	Yr. 1	Yr. 2	Yr. 2	Yr. 2
TECH 3103	Safety Technology	●					
TECH 3113	Quality Technology	●					
TECH 3133	Manufacturing Technology		●				
TECH 3143	Production Planning & Control		●				
TECH	Project			●			

Code	Course						
3153	Planning						
TECH 3163	Supply Chain Technology		●				
TECH 4103	Innovation			●			
TECH 4113	Facilities Design			●			
TECH 4123	Energy Technology				●		
TECH 4133	Construction Technology				●		
BAAS 3113	Internship						●
BAAS 4113	Capstone Project						●

Code	Course						
5333	Change in Industry						
TECH 5343	Global Production						●
TECH 5403	Competition & Innovation					●	
TECH 5133	Resource Planning	●					
TECH 5143	Product Development		●				
TECH 5413	Design for Manufacturing (Capstone Project)						●

● Required Courses

V. NEW PROJECT

Based on the success of the BAAS Technology Program we have designed a Master of Science program in Industrial Technology. Students in the Master of Science program will take two online courses each semester for two years just like the BAAS Technology Program. These online courses will be developed and taught as online courses in our D2L (Desire to Learn) learning management system (LMS). Many technology students with bachelor's degrees need graduate degrees to move into upper technical leadership positions. Online education allows them to keep their job and pursue higher education, so they can move up in their careers. A two-year online course rotation cycle developed for the technology courses is shown in Table 3.

The program requires 30 credits, 12 of which are taken in a required core. A purpose of the core is to provide knowledge in communication and research. The remaining 18 credits are elective courses, which may be within an area of specialization to meet the individual's specific professional and personal objectives. In some cases, students may select courses to enhance their technical competency. In other cases, individuals may select courses to prepare for a change in responsibilities or job function.

TABLE III. SEQUENCE FOR MASTER'S ONLINE COURSES

Course #	Course title	Yr. 1	Yr. 1	Yr. 1	Yr. 2	Yr. 2	Yr. 2
TECH 5153	Communication in Industry	●					
TECH 5243	Problem Solving in Industry		●				
TECH 5303	Research Methods in Industry				●		
TECH 5313	Industrial Employee Training					●	
TECH 5323	Industrial Organizational Change				●		
TECH	Managing			●			

We are following the guidelines of ATMAE (Association of Technology, Management and Applied Engineering) in designing this program as in Table 4: Master's Degree Programs/options shall be a minimum of 30 semester hours and shall meet the following minimum/maximum foundation semester hour requirements (Table 4):

TABLE IV. M.S. INDUSTRIAL TECHNOLOGY PROGRAM

Communications and/or Problem Solving (TECH 5153, TECH 5243)	6-12 credits
Research (TECH 5303, TECH 5413)	6-12 credits
Management and/or Technical	12-18 credits
Electives	0-6 credits

VI. CONCLUSION

Students with associate degrees need four-year degrees to move into supervisory positions. Online education allows them to keep their job and pursue higher education, so they can move up in their careers. Students with bachelor's degrees can take the graduate courses and get a master's degree to move into upper technical leadership positions.

The advantages of online education are learning anytime and anywhere which is especially good for working adults including those that have to travel as part of their job. The use of online education in technical education is growing. E-learning is the new name applied to internet based online education. Online education also helps with scheduling and program costs. Many online students are older working adults balancing studies with demand of family and work.

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