

Following Engineering Graduates

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This study provides an in-depth analysis of recent graduates' experience with completing an engineering technology program and entering the profession. It is unique because the study was conducted on a baccalaureate-level program and because it helps fill a gap in the literature. The phenomenological method was used to obtain qualitative data to understand the personal meaning of the process for the participants. Findings include positive perceptions about the curriculum and faculty, and some areas for improvement. The graduates found personal meaning especially in their capstone course and by being involved with the engineering student organization. There are implications for program evaluation and educational leadership.

Key words: program evaluation, phenomenology

The purpose of this study was to investigate the phenomenon of industry-employed graduates of the Bachelor of Science in Heating, Ventilation, and Air Conditioning (HVAC) Engineering Technology at Ferris State University (FSU) in Big Rapids, Michigan. In particular, the research sought to learn what the educational experience meant to the graduates, how they perceived they were prepared for work, what they consider to be the essential elements of the program, and what changes they would make to improve it. Most studies of Career and Technical Education (CTE) programs are quantitative in nature (Bozick & Macallum, 2002; Bragg & Russell, 1993; Brown & Conbere, 2005; Coryn, Gullickson, & Hanssen, 2004; Kagaari, 2007; Rahn, O'Driscoll, & Hudecki, 1999) and focus on descriptive statistics such as enrollment, retention, graduation rate, and employment rate. However, efforts to collect data related to how graduates apply their learning on the job and how they impact their place of employment are often neglected due to the constraints of time and money (Zinser, 2003). Given the role of CTE to prepare students for success in the world of work, data related to graduate performance on the job might be more significant than statistical counts of student numbers, or student performance in school, in regard to curricular improvement. In many cases

the industries that CTE programs serve are relatively unique so there may not be a benchmark against which quality can be measured; in that situation each program would need to be evaluated as a separate case, although a similar process may be used for different industries.

The Bachelor of Science in HVAC Engineering Technology does not fit neatly into any one-career cluster or serve a major industry. Created in the mid-1980s for a specific industry sector, it was designed to be more application oriented compared to a general engineering program, making it unique in higher education. In addition, it is a baccalaureate-level degree, whereas most CTE programs are placed at the high school and associate degree levels. The market for which it prepares students is not local or even regional; it is national and occasionally international in scale, yet the program itself is relatively small. Graduates accept jobs at companies that vary widely in size and scope; some have less than 10 employees and serve a local market while others have thousands of employees with branches throughout the world.

Similar to other institutions, FSU collects internal assessment data in the form of Academic Program Reviews; the last one conducted in 2006 indicated a high level of quality as perceived by key stakeholders, including students, graduates, employers, faculty, and advisory committee members. Participants responded to typical survey questions and provided short, one-sentence comments for a number of open-ended questions. The data provided by the Academic Program Review was mostly positive and provided a basic quantitative measure of stakeholders' perceptions of quality. Responses to open-ended questions provided supplementary information, but sufficient data were not available for analysis. Further, the use of a simple survey instrument is inadequate for additional probing and in-depth questioning. In order to gain a better understanding of how quality in the program is achieved and what opportunities exist for curriculum improvement, a more in-depth analysis using a qualitative design was necessary.

Background Literature

Program Evaluation

Evaluation is a process that determines the worth of something. In education, evaluation is commonly used to assess the value of specific courses for students. Rarely however is a complete program submitted to a rigorous evaluation by external standards. Yet most technical education degree programs have a built-in accountability to the community that hires its graduates; the curriculum and equipment must be kept up to date according to what is used in the industry. Evaluation therefore can serve as an audit of a program to solicit ideas for improvement and to resolve any problems (Zinser, 2012). The procedures for conducting evaluation studies vary along a spectrum of complexity. An evaluation could be mostly informal such as asking students how they are doing in the program; second, the process might be semiformal by including discussions with an advisory committee or representatives from the related industry; third, a formal evaluation is sometimes conducted by an external reviewer much like a research project. Similarly, what gets evaluated can range from a single course to the entire system required for the program to function: funding, facilities, curriculum, faculty, student participation, learning objectives, and final outcomes such as employer satisfaction with the graduates. Many different data collection methods can be used, depending on the aspect of the program under study.

An evaluation approach that has been used in industry for many years is the four-level valuation developed by Kirkpatrick (1994). Although it was designed for corporate training programs, not necessarily for education, there are some similarities that can be readily adapted.

1. **Reaction:** measures how the participants liked a specific learning experience; it could include their perceptions about the teacher, the content and methods, and even logistics such as the facility and schedule. The participants should have positive reactions in order to motivate them to continue learning about the topic and to use the skills in practice. Student opinions are typically measured with simple feedback forms at the end of the course and the results are generally used informally by the instructor to make adjustments as necessary.

2. **Learning:** measures how much the participants improved knowledge, increased skills, and changed attitudes resulting from a

course. The assessment of learning is the most common evaluation method used in education, for which educators have considerable expertise. Teachers use a variety of written tests to measure specific learning objectives especially at the knowledge level. The assessment of skills is more widespread in technical subjects and is accomplished through performance demonstration by the learners. Measuring student attitudes is less common, perhaps due to the intangible nature of the affective domain; however, an attitude such as safety is important in technical education and can be measured indirectly by observation of specified activities.

3. **Behavior:** measures the extent to which students changed their behavior as a result of the educational experience. (It actually focuses on job performance, not “behaviors” like attendance.) To measure behavior it may be difficult to isolate the effects of the training because of other variables such as learner motivation, the work procedures, and organizational climate. This evaluation level is more challenging and time-consuming because it requires follow-up with participants after the training, but such an analysis can provide meaningful feedback about the program. By asking former students how they perceive they were prepared for work, faculty may discover that students believe there are some gaps and some redundancies in the curriculum, for example, which could be easily corrected. Evaluating behavior is best done through pre- and post-measurements of performance and by conducting interviews with the participants and their supervisors.

4. **Results:** refers to the actual benefit for the organization from the educational experience and is usually expressed in “bottom line” measurements such as reduction of errors or increased profits. Although this may be the most important level for the employer, it is also the most challenging to quantify the results of education. In the context of program evaluation, however, employers usually expect that graduates have the right skills, which reduces their training cost, and that the number and quality of prospective workers has increased. Evaluators of a program must utilize well-defined success criteria to demonstrate its value, and when a program is regarded as successful, the organizations are very likely to support the program and even increase their support.

Knox (1998) developed a comprehensive model for program evaluation involving eight stages, coordination, and interpersonal considerations. This process is similar to project management in general, but the key concepts for the current discussion are the identification of stakeholders and agreement on exactly what should be measured (or the success indicators). For technical education, external stakeholders are usually the employers who hire the program's graduates, and the measures of success are the sufficient number and quality of prospective employees. The data collection methods are then chosen depending on the nature of the data source. For example, student or graduate perceptions are commonly measured by surveys, interviews, and focus groups. Advisory committee members or other experts who employ the graduates are usually interviewed. The curriculum can be assessed by comparing its objectives with professional content standards.

Therefore, the effectiveness of college education, as measured only by knowledge of student learning (Millett, Stickler, Payne & Dwyer, 2007), is not a sufficient evaluation. To increase accountability, more CTE programs may need to conduct follow-up studies with their graduates and the companies that employ them. Key stakeholders need to know that the program is relevant: professors want to know that their teaching is meaningful, administrators want to know that funding is justified, employers want to know where to find qualified employees, and prospective students want to know how their program of study will prepare them for the world of work (Feutz, 2010).

A quantitative design such as a follow-up survey describes the characteristics of the program and its graduates as a statement of the numerical value of one or more observable parameters (Glass & Hopkins, 1996). The extent to which graduates perceived they were prepared in areas of specific course material and the importance of that material to their job can also be measured. Similarly, a scaled survey is sometimes used to measure the extent to which employers believe graduate employees exhibit attributes of skill, knowledge, and attitudes. Such evaluations may be more common than is known through the literature, likely because institutions use the results for internal purposes. Although valuable, these data generally do not explain how course materials or graduates'

attributes contributed to job success, nor could they explain what was useful about the material or attribute (Feutz, 2010). In contrast, a qualitative design answers "how" and "what" questions that allow exploration at a deeper level of understanding through inquiry (Creswell, 1998; Locke, Spirduso, & Silverman, 2007; Marshall & Rossman, 2006).

Qualitative Research

Many traditions or methodologies of qualitative inquiry exist; each one has unique features and characteristics for various types of study. Though many studies combine elements of two or more traditions (Creswell, 1998), this study most closely aligns with the characteristics of a phenomenology. A phenomenological approach is best employed in situations bounded by temporal and physical limits (Lancy, 1993), and it is used to study the lived experiences of several individuals to describe the "essence" of a phenomenon through the personal meanings of that experience from the subjects' perspectives (Bogdan & Biklen, 2003; Burke & Christensen, 2004; Creswell, 1998; Marshall & Rossman, 2006; Patton, 2002).

This study used a phenomenological design to gauge the alignment of the HVAC Engineering program with its industry, as measured by the perceptions of graduates. A phenomenology is used to study a specific experience shared by a relatively small number of people, purposefully chosen as a nonrepresentative sample (Bogdan & Biklen, 2003), using a systematic yet flexible in-depth interview structure based on open-ended questions (Bogdan & Biklen, 2003; Burke & Christensen, 2004; Creswell, 1998; Marshall & Rossman, 2006; Patton, 2002). The phenomenological method was chosen for this study because it offered opportunities to interact with subjects on a human-to-human basis, to explore further if necessary using follow-up questions, and to arrive at conclusions post hoc rather than a priori (Creswell, 1998; Lancy, 1993). Through this method, the research progresses inductively, with the researcher trying to make meaning out of the data. Preconceived notions or conclusions are not a part of qualitative inquiry, because they may cloud the researcher's findings (Bogdan & Biklen, 2003; Marshall & Rossman, 2006). Rather, the researcher attempts to remain as open-minded as possible, so that the meaning emerges from the data. Such a strategy allowed the exploration of the subjects' perception of the

HVAC program in great depth to determine the extent to which graduates were successful in the school to career transition. A qualitative assessment can bridge the gap between measures of school performance and job performance (Bragg & Hamm, 1996).

Research Questions

To comprehend the phenomenology of engineering graduates, the following research questions were employed:

1. What does the HVAC program mean to its graduates on a personal level?
2. How do graduates perceive they were prepared for their careers?
3. What are the essential core academic, general education, and nonacademic elements of a relevant HVAC program?
4. What changes, if any, could improve the HVAC program from the perspectives of pedagogy and relevance?

The answers to these questions reflect the perceptions of the graduates who participated in the study. These data provided a detailed portrayal of the strengths and weaknesses of the HVAC degree. Perhaps more important, the study brought to light what the degree means to graduates. These data supplied several measures of program quality and will be used as a basis for program improvement. The evaluation process may also be employed for other CTE programs.

Methods and Procedures

To recruit subjects for the study, contact information for all 110 HVAC graduates from the years 2007, 2008, and 2009 was solicited from the FSU administration. The size of the sample was relatively small, as is common in qualitative inquiry (Bogdan & Biklen, 2003; Creswell, 1998; Locke, Spirduso, & Silverman, 2007). The sample was also purposeful and involved only graduates from these three years. The reason for this delimitation was to interview those who were relatively new to the workforce. As time passes, it may be more difficult for graduates and employers to determine which knowledge and skills were learned in school and which were acquired through experience on the job. Therefore, subjects were not too far removed from their educational experience yet they have been in the workforce for a sufficient

time to allow for reflection. The companies that employ the graduates vary by size, scope of work, geographic location, and geographic market.

After receiving approval from the university's human subjects review board, all potential subjects were invited to participate via an email message, and a second invitation was sent one week later to those who had not replied. A goal for the subject selection was that the experiences of both on-campus ($n = 88$) and online ($n = 22$) graduates would be represented; though the ratio of campus to online graduates is four to one, a similar sample size would have allowed for a comparison of themes between groups if that phenomenon arose. A total of 21 graduates (19%) responded to one of the two emails; 18 were successfully contacted and expressed willingness to participate. This sampling provided a diverse, nonrepresentative group. Because of the small number of program graduates, and the narrow focus of the study, the results are limited and should not be generalized to other populations or programs, although the evaluation process could be replicated widely.

The instrument of inquiry for this research was the open-ended, in-depth interview protocol, consisting of the four basic questions that were conducted over the phone due to the geographic separation among the subjects, and these were recorded to ensure accuracy. Qualitative interviews are conversational and exploratory, beginning with social conversations, and based on a few general topics (Moustakas, 1994). The subjects' responses were allowed to unfold in whatever form they wished to frame the discussion. The open-ended questions were designed to obtain data in a way that did not lead the subjects (Marshall & Rossman, 2006).

A total of 18 interviews were conducted. Ten of the subjects graduated from the traditional on-campus program and eight graduated from the online version, which presented an opportunity to analyze an additional variable. The two groups are highly differentiated by their age and years of experience (Figure 1); the on-campus participants were generally traditional college-age students, whereas the online students were typically aged 30s to 50s and already working in the field. Participants were asked to reflect on their educational and work experience and to explain how they felt they were prepared for their jobs. Follow-up questions were asked as

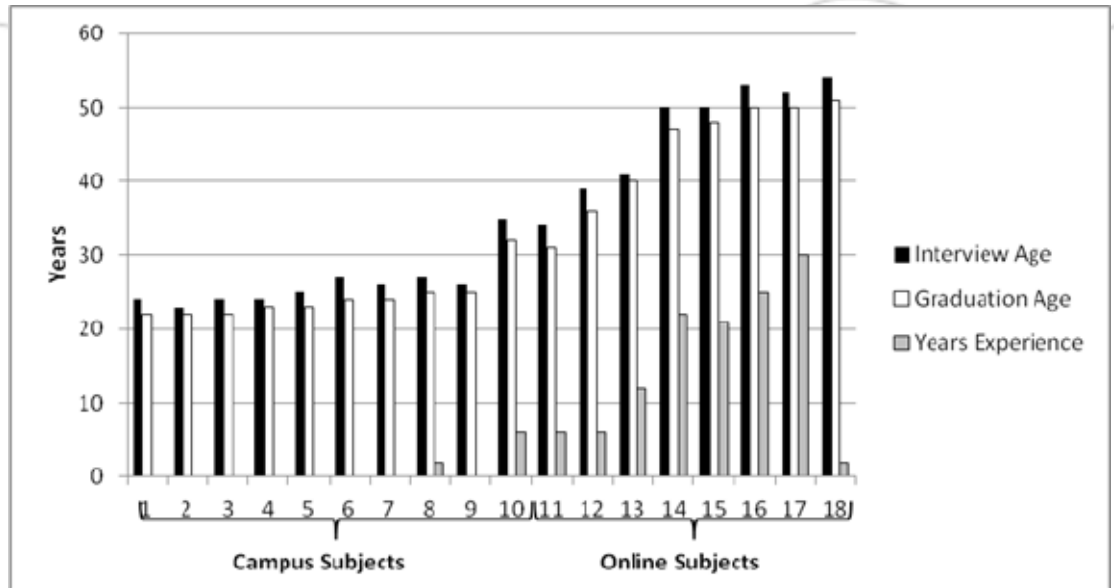


Figure 1. Subject Demographics

needed. Code numbers and pseudonyms were developed to provide anonymity. After the interviews, “member checking” was used to validate interpretations and descriptions of the experience. This involved asking interview subjects to review the transcripts in order to ensure that the experience was captured accurately from the perspective of the subjects and with minimum bias (Burke & Christensen, 2004). To organize the data, audio recordings of each telephone interview were transcribed; the data was coded via Excel through a process known as “phenomenological reduction” (Creswell, 1998). During phenomenological reduction, the researcher seeks to discover facts and themes that disseminate from the data; the researcher sets aside beliefs and knowledge of the phenomenon so that the true essence can be discovered from the perspective of the subjects. In all, 58 distinct headings were created to code the data. The headings were then clustered with other headings of similar meaning into six main themes that emerged in the study.

Findings

Based on the responses to the four research questions, six common themes (Figure 2) emerged for both campus-based graduates and online graduates. In general: (a) graduates think positively about the HVAC curriculum; (b) general education does not contribute significantly to the HVAC experience; (c) graduates find deep personal meaning in the HVAC experience; (d) assets and attributes of the program and the university contributed significantly to the positive experience of the graduates; (e) graduates are well-prepared for work; and (f) there is room for improvement. These themes are discussed in the following sections, which include a few highlights of how campus and online graduates differed. Pseudonyms are used whenever a subject’s name appears.

Theme One: Strong Positive Attitude Toward HVAC

All subjects who graduated from the campus program chose the degree because it seemed to be a fit, piqued their interest, or allowed them to

<p>1. Positive Attitude: *Focused curriculum *Challenging courses</p>	<p>2. General Education: *No direct value *Communication skills</p>
<p>3. Personal Meaning: *Gratitude *Self-fulfillment</p>	<p>4. Quality Educational Assets: *Supportive faculty *Student organizations</p>
<p>5. Graduates well prepared: *Work-based learning *Early responsibilities</p>	<p>6. Suggested changes: *Professional accreditation *Project management</p>

Figure 2. Graduates’ Thematic Perceptions

advance in their careers. Of the factors cited for making their decisions, subjects often spoke of the concentration on HVAC and the narrow focus of the program. Nick described how FSU helped him find a direction in school: Tony described how the program had given him an advantage over graduates of mechanical engineering programs that “just taught theories” and were “broad spectrum,” whereas FSU was “very precise.”

Though some subjects said they were good at it while in school, they also found the curriculum “challenging” or “difficult.” At the same time, they saw the value in the challenge via the knowledge they gained. Subjects discussed the curriculum as a whole, but they also used individual courses to make their point from time to time, whether talking about their experience in school or on the job. The first course taken during the first semester of the HVAC program (HVAC 331 Secondary System Selection and Design) was described by some of the subjects as somewhat of a gateway course to the program. Where subjects saw HVAC 331 as a gateway to the degree, they saw the capstone course as culmination of their learning, and sometimes as their rite of passage. HVAC 499, as the capstone course, allows students to concentrate in an area of interest to them. Each year, students of the HVAC program submit their HVAC 499 capstone projects to be judged in an international student design competition. For John, HVAC 499 had the same effect. It focused the program, it had significant meaning for him, and it provided him with insight for his career.

Theme Two: General Education Courses

The investigators were interested in a holistic view of the HVAC degree. This included not only the core courses, but also the general education courses that are required for graduation. Overall, the responses were mixed. Unlike subjects who remembered specific HVAC courses and details within specific courses, these participants sometimes struggled to remember individual general education courses they had taken. Others mentioned a specific course that had meaning for them, or piqued a personal interest. Communication courses were most often cited as helpful. Josh said, “I guess you could say it helps you become a well-rounded person.”

Theme Three: Personal Meanings--Pride, Gratitude, Self-Fulfillment

For the campus graduates, the strongest personal meaning was a feeling of pride in

earning the degree. Although that feeling was not always explicitly stated, it was inherently obvious during the conversations, particularly when the subjects described their accomplishments on the job and their skills relative to coworkers who had earned their college degrees elsewhere. Josh, Brian, David, Brandon, Jordan, and Tony had all used coworkers or other graduates as a benchmark for their skill set. David had much stronger feelings and spoke at length about his gratitude, saying that the program and the faculty:

have contributed to an excellent three years in the real-world and a great excellent four years in the college world as well . . . [It has] put me in many of the positions of success that I enjoy to this day, and I am very, very grateful . . . I do owe . . . a great deal of gratitude and thanks for the things that I get to enjoy in life now.

For others, the degree represented an opportunity to grow; it gave them a feeling of accomplishment and perhaps even self-fulfillment. Tony thought the experience “was pretty significant.” He explained, “I felt that it was definitely a significant change that someone like me who is technical based, um, you know, struggles in English, struggles in just schooling in general that wasn’t technical . . . I never thought that I would be able to do something like that.”

Theme Four: Quality and Supportive FSU Educational Assets

“FSU assets” is a term to describe the characteristics of the experiences that had meaning for the subjects. The curriculum is a prime example of a characteristic. For many, either a favorite professor or the faculty in general were significant. Jack spoke both of his feelings for the faculty and of his perception of their attitude: “I liked every single teacher; they really did put a good effort into wanting you to learn the subjects.” For Josh, the faculty members were included as factors in his personal growth: “The program and the teachers in the program really helped me become who I am today.”

Second, several of the subjects discussed the social aspect of their campus experience, including personal interaction with faculty. Friendships were forged that had a meaningful impact on the lives of others. David’s story is a perfect example. He actually landed his job based on information received from a friend. The third asset mentioned is the HVAC

Building, which was built in 2003 and designed with the mechanical, electrical, and plumbing systems exposed to enhance teaching and learning. The subjects involved in this research were among the first students to take courses in the new structure and the features of the building resonated with them. Many mentioned that the facility impressed them while visiting campus, and they enjoyed taking classes there for two years.

Another asset of the FSU program is the engineering student organizations; all but two campus subjects mentioned the organizations as significant. These student organizations provided opportunities for the subjects while they were on campus. In addition to campus activities, each organization hosts an annual conference, convention, or exposition at various locations throughout the United States. Students raise funds to attend or find sponsors to fund their travel expenses. Some of the organizations also sponsor student competitions, including the HVAC design competition that subjects spoke of on several occasions. Involvement in these organizations proved to be a significant element of many of the subjects' experience, particularly the opportunity to travel. Through the student organization sponsored trips, the subjects saw different parts of the country, developed their networks, and discovered new opportunities within the industry.

Theme Five: Well-Prepared Graduates

The overarching question for this study was: How do graduates perceive they were prepared for the industry as measured by what they know and know how to do as compared to what they need to know and be able to do? This theme answers that question, although it was often difficult if not impossible to extract and then separate salient points related to curriculum and work. Subjects used work examples to make their points when discussing the curriculum, and they used the curriculum to make their points when discussing their work.

Internship. The discussion began with the internship because, as both a required course and work experience, it illustrates the intricacy of the relationship between school and work in the HVAC program. As the first exposure to a full-time work experience for many subjects, the internship made the all-important connection between the world of school and the world of work, and, indeed, directly linked half of the campus subjects to full-time employment. Josh,

Brian, Austin, Jack, and Tony parlayed the internship they served between junior and senior years into full-time employment upon completing their last year of school. A mock interview held during an advisory board meeting led to an official interview and subsequently a job for John. Many of the subjects spoke at length about the internship and their experiences. Comments from Josh's interview demonstrated how the internship provided the opportunity for an individual to "transition from an uncertain young college student to a confident young man ready to tackle the workforce."

During his internship, he gained experience with one manufacturer's controls in particular and learned controls using equipment from another manufacturer in the labs at FSU. Though neither company hired him, his portfolio documented his internship experience and helped him secure a job upon graduation with a third controls company. Since he "already knew two of our competitors' control systems," he found that the knowledge and experience gained through the internship and at school "helped out in certain scenarios." In hearing of the internships from the viewpoint of the subjects, it became evident that experiences were particularly significant to them. The internship seemed to be a transformational point in their lives, and as Josh articulated, "[he] grew up." It also gave them a chance to apply their knowledge and gave them confidence in what they knew and could do.

Another comparison between FSU graduates and other graduates was offered by Tony, who described how the limited expertise that he gained in HVAC 451: Energy Analysis and Audit led to considerable responsibilities for him on the job:

I am the only person at [my company] that has done any energy modeling . . . we've got a full floor above me upstairs that is project engineers, project managers, and full-blown P.E.s [Professional Engineers] and they've never done energy and that is something that they really look to me . . . to help them . . . justify energy programs and energy projects and . . . retrofit opportunities.

Whereas conducting energy auditing has simply been added to the responsibilities of both Tony and John, David actually carries the title of Energy Engineer. This is a position he secured

because of the knowledge he gained through the HVAC program and HVAC 451 in particular. David's description of his duties read like the 451 course description.

Deep End of the Pool. Many subjects found themselves with significant responsibilities soon after beginning their job. Most often, though not always, this was a confidence builder for the subjects. For Tony, as the only employee at his firm capable of performing energy audits, the knowledge that he acquired in HVAC 451 amounted to a double-edged sword. Out of school only one year, the responsibilities that he had gained were a bit intimidating, yet through his knowledge, limited though it was, he gained the trust of his superiors and colleagues.

Theme Six: HVAC Is Not Perfect

Asking, "What would you change about the program?" enabled the interviews to take on a richer and more in-depth narrative describing the experiences of each subject. Two topics came to the surface: the lack of professional accreditation and the need for a business-related course. In brief, the HVAC program is not accredited by the Accreditation Board for Engineering and Technology. This was a conscious decision by FSU to provide a more narrow industry focus rather than the broader mechanical engineering program. However, this choice prevents graduates from becoming licensed or registered as professional engineers (P.E.s). HVAC graduates can do everything a P.E. can, but they lack the authority to sign or "stamp" engineering documents and take legal responsibility for them.

The second main subtheme to appear under opportunities for improvement was the addition of a course, or at least learning objectives, related to the business side of the industry. Representing the perspective of other subjects, Tony felt that he was not prepared for the "whole management of time and people and resources. I felt like I wasn't really prepared enough." Along the same line of thought, Brandon said, "one of the things I felt was a weak point is just learning about the different parts of a job . . . how the whole bid process works and how a job evolves."

The Online-Degreed Graduates

All of the online graduates who participated in this study chose the online option for its convenience. All were employed while earning

their degrees, and with all but one living outside of the state, they were able to continue working and living at home. For the online subjects, the curriculum varied in meaning from the campus subjects. Though they certainly felt it was a "real-world" experience as the campus subjects did, they also found it to be enlightening. Because they already had extensive industry knowledge, some found there was much more to know and learn. Others found portions of the curriculum to be familiar territory, thus validating the work they had been performing during their careers. With his extensive field experience, Nathan found the HVAC program to be enlightening. While in the field, he had known enough to "make the stuff work" but he did not always understand why (which seems to be the reverse of campus students). Online students also spoke about the capstone project and its real-world application. Josh said: ". . . and the situation that you run into in real life is there may be more than one solution to a problem and it's up to you to decide which solution you want to use to best help that customer. And it's not textbook, although you do use textbooks to come to a solution if you have questions about a particular situation."

For the online subjects, interaction with faculty was limited to electronic or phone communications, with one exception. As students, they started in the fall of their enrollment year with the first HVAC course. During the winter semester they took the second HVAC course, followed by the third during the summer. In August of that first summer, they all traveled to campus for a five-day hands-on laboratory learning experience. During this time they met each other, their professors, and their advisor for the first (and only) time. Several graduates commented that faculty members were highly regarded in the industry, and it was rewarding to meet them in person.

Many of the social aspects of college can be lost in the online format, particularly when the students are scattered across the country as they are in the HVAC online program. Yet the subjects managed to find social interaction with fellow students and with the faculty and staff of the university and established meaningful relationships in the process. John related that "as I went on [in the program] I got introduced to students that were online and we formed a network where we could discuss things with people from different parts of the country."

To enhance online learning, faculty recorded and edited their lectures and provided students with CDs containing all the lectures and other materials that were needed to supplement written materials. Faculty members were pleased to hear that students believed the CDs were effective tools. As Tyler noted:

I think CDs are the way to go because the student can get out of school and he can refer back to those CDs for years . . . I thought that was excellent . . . that is very important. I'm the type person that when I go to a class, especially one that is important in my field, I keep all that data and I categorize it and put it in notebooks or crates. And that way I can refer back to it over and over as I have in the past.

Other subthemes emerged when subjects were asked what they would change about the HVAC program. Online graduates noted that some of the materials they received either contained errors or were outdated. There was a delay in communication associated with online learning. Subjects cited specific courses where feedback from their professor was delayed by up to a month. One subject expressed the feeling they were "drifting for several weeks at a time." Even with the normal communication lag expected when using electronic communication in the form of email, when faculty schedules did not align with student schedules, the students had no way to ask a question and get an instant response unless they happened to be in a live chat room. Because they had full-time jobs, subjects found themselves working on their courses during the nights and weekends, which were often the times when faculty were not at their computers. Greg did not comment on communication issues, but he did complain that general education courses were difficult for online students to take because of the limited offerings. He acknowledged that FSU had added more courses as time went on, but for him, many of those courses came too late and he struggled to find the general education courses that he was required to take.

Review of differences. To summarize the comparisons between the two groups of graduates, several facts differentiated online subjects from the campus subjects relative to the world of work. First, for the campus subjects, their internships were significant features of their HVAC experience. The internships led to

full-time employment, provided the connection between school and work, and helped the students mature. The online subjects did not serve internships. Though the internship was required of them, their HVAC-related job experiences allowed them to earn their internship credits through a proficiency-by-portfolio process. Also, because they had an average of 15.5 years of work experience, the internship would not have provided the same meaningful introduction to the world of work as it had for the campus subjects.

Second, while the campus subjects felt they entered the job market at the "deep end of the pool," the online graduates had already been in the "pool" for years, so while this was a significant experience for the campus subjects, it was not a factor for the online subjects. Third, the campus subjects measured themselves against their coworkers who had graduated from other institutions, and often with a degree in mechanical engineering. The campus subjects believed they were better prepared than their counterparts. That experience did not emerge with the online subjects, as they were seasoned veterans with significant expertise even before they earned their HVAC degree; thus, there was no need for them to find a benchmark against which they could measure themselves. Finally, some of the online students needed the baccalaureate degree to either secure their job or to be eligible for promotion within the same company. Like some others, Steve did not need a baccalaureate degree for employment or promotion purposes, having progressed far into his careers with only an associate degree, but he wanted a baccalaureate for reasons of personal fulfillment.

Discussion

This phenomenological study served as a tool for program analysis and improvement. When asked about their experiences, the subjects defined their personal meanings using specific elements of the program. When viewed from the perspectives of its graduates, the strengths and weaknesses of the program became apparent, and two critical elements of its invariant structure emerged. First, the program aligned sufficiently well with students' needs and interests in a technical degree to be described as a good fit for them. Second, the data revealed that the curriculum aligned precisely with the sectors of industry for which it was designed. Because of these alignments, graduates perceived the program as the premier

educational experience in their field and exhibited feelings of great personal pride and a sense of accomplishment due to their affiliation with and graduation from it.

With the long history of CTE as workforce development or education for jobs, and federal legislation to regulate that education, this study reinforces the importance of a curriculum that is aligned with the industry for which it prepares its students, and it provides strong evidence that a unique CTE program can and does have a role in the current educational system. The strong feelings of the participants that the HVAC program fit their needs, provided excellent preparation for their careers, and fostered a strong sense of job security seem to highlight the merit in narrowly focused CTE curricula.

From the perspective of credibility, though the public perceives CTE as something less than academic (Cohen & Besharov, 2002), the pride and success projected by the participants of this study indicate just the opposite. This carries the implication that quality CTE programs can have as high a value as academic programs. It follows that efforts to increase the quality across the spectrum of CTE could improve its perception in the public eye. In addition, publishing and promoting the results of effective programs can help demonstrate their significance. An important distinction

must be pointed out: the HVAC program is a baccalaureate-level degree. This is an anomaly within CTE, as the vast majority of programs exist at the secondary or associate degree level. Perhaps this study makes an argument for elevating more CTE programs to the baccalaureate level.

Though existing quantitative data had indicated a high level of quality in the HVAC program, this qualitative study provided answers to "how" and "why" questions and identified areas of strength and areas of weaknesses in which quality improvements could be made. In fact, the study would still be valuable to the college even if the results were more negative. To further the research, perhaps the qualitative findings from this small sample could be used to develop a quantitative survey instrument for administration to a larger sample to provide results that would be more generalizable, so that the evaluation process could be replicated for other CTE programs.

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