Evaluation of a Nuclear Energy Production Technology Program

By Kenneth W. Flowers and Richard Zinser

ABSTRACT

This study investigated the perceptions held by key individuals within the energy industry involved in the development of an Energy Production Technology degree program at a Midwest community college to help address the need for qualified workers for the local nuclear power plants. Through open-ended interviews and surveys, the mixed methods case study collected data from 34 Energy Production Technology (EPT) program graduates, seven EPT program advisory committee members, and four employers of graduates in the energy industry. The findings revealed that the program was successful for creating a supply of qualified technicians; the employers and graduates equally believed that the program adequately prepared technicians for employment. Lessons learned include having a realistic labor projection and knowledge of employability requirements, and making sure all the right stakeholders are involved in the program development process. The study has implications for policy and practice in career and technical education, especially for those who work closely with industry.

Key words: energy industry training, program evaluation, community college

PROJECT BACKGROUND

According to the Nuclear Energy Institute (NEI) over one-third of the current workforce in the industry may be retiring within the next five years, which will require training and hiring about 25,000 new workers (NEI, 2010). To address the projected shortage of energy industry professionals for the region it serves, the community college in this study, through a partnership with the local energy industry, developed an Energy Production Technology degree program to give local individuals looking for employment the opportunity to prepare for high-skilled, high-wage jobs in the energy field. Due to feedback from local energy employers, the community college was sought out, because, historically, the commercial nuclear industry counted on the U.S. Navy to provide technicians for civilian jobs, but the size of this group has decreased over the years while the demand has increased.

This program was developed in part by following the curriculum outline that was established by the Nuclear Uniform Curriculum Program (NUCP) created in 2007 by NEI. The NUCP was created as a quasi-accreditation process to guide community colleges to help power plants staff their future workforce, and it is a standardized program for educating operators and technicians for jobs at nuclear plants (NEI, 2010). Based on a review of the literature, prior to 2007, there is little evidence of a concerted effort between nuclear power plants and community colleges to engage in such a partnership. The NUCP program requires a common curriculum regarding plant equipment and systems, science and mathematics, and technical electives in a student's chosen focus area (chemistry, operations, health, physics, radiation protection, and maintenance).

Regardless of NEI involvement, prior to the development of an energy-focused program, one of the concerns often unfamiliar to any college that attempts to develop such a degree program is that the power production industry is highly regulated. According to Laraia and Dlouhy (1999), "the laws and regulations are often complex and overlapping, involving several government ministries, departments, and/or agencies. These laws and regulations typically provide licensing of various aspects of the nuclear industry, government oversight, setting of standards (both technical and environmental), and protection of human health from radiological (and other) hazards" (p. 40). Safety is a preeminent concern in the nuclear industry, not only for its own sake, but also because of its sensitivity in terms of public perception and, formally, because of national and regional regulations and international agreements (Organisation for Economic Cooperation and Development [OECD], 2012). Local Energy partners supported this, by characterizing the importance of a high level of education and training to maintain the level of safety necessary for the plants to run successfully.

RATIONALE FOR THE STUDY

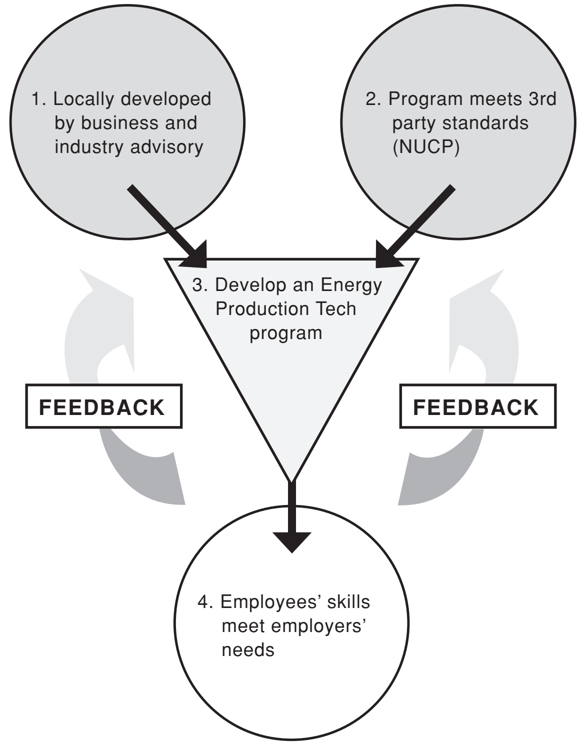
The purpose of this research was to determine the perceived success of the new Energy Production Technology program created in partnership with a community college and its local business and industry service district. It was essential to assess the feedback process within this partnership to determine if the program was yielding effective results as perceived by program graduates and their employers. Equally important was to determine the role played by the advisory committee that was developed to implement and provide oversight to the program.

A principal goal of community colleges is to ensure that the workers in the region they serve have the educational tools needed to survive in today's job market (Government Accountability Office, 2008). In order for any degree program to remain viable and relevant, it must prepare highly skilled individuals who are aligned with the changing needs of a given industry. To do this, the labor force and educational organizations should be structured around integrated education, training, and program evaluation processes (Government Accountability Office, 2008). For employers, this extended effort provides opportunities for recruiting and training new employees, additional skills for incumbents, and potentially improving retention.

Assessing the success of a program is vital to provide the best service to stakeholders. According to Epstein, Coates, Wray, and Swain (2006), "The stakeholder's role is broader than being a customer of services, because the conditions citizens experience in the community and in their lives are affected by many things other than community services" (p. 27). Success depends entirely on how community colleges, along with their region's stakeholders, can effectively collaborate and bring collective resources to bear on the challenges facing them. Yet there is little published research on the evaluation of technical programs at this level (Zinser, 2003).

CONCEPTUAL FRAMEWORK

As graduates become employed in the industry, it is important to evaluate the validity of the training that is provided by the college. A continual feedback loop of evaluation and improvement should be developed as both the college and industry review and adjust perceived curriculum and employment outcome gaps.



Locally Developed by Businessand Industry Advisory Committee

When developing a new program at any college, there must be coordination across key state, local, and stakeholder agencies. According to a report by MPR Associates (2010), "Development of programs of study includes analysis of current labor market information to determine which programs of study will truly result in high demand jobs, input from stakeholders that is genuine and sustained, and funds dedicated to both initial development of POS as well as sustenance through curriculum development and business and education input" (p. 15). Once these pertinent data are collected and reviewed, if validated, local business and industry partners in the community convene to form a program advisory committee to cultivate the program.

Program Meets Third Party Standards (NUCP)

A key benefit of the NUCP is that once graduates who earn this certificate are hired at the plant, they can be waived or exempted from portions of required initial training. By evaluating and accrediting the community college training programs, this waiving or exemption of training is a cost-saving measure for the power plants allowing the plants to then redirect those financial resources to other areas. Organizing industry partnerships with two-year education programs helps leverage resources to provide the next generation of highly skilled workers (NEI, 2010).

Develop an Energy Production Technology Program

The strengths of the program developed by the internal analysis included strong support from the local power generation industry, industry-experienced adjunct instructors, strong base of potential workers due to manufacturing shortages, NEI pilot program, and strong government (and public) support for renewable energy. These strengths support the framework focus centered around the advisory committee (strong support from local industry), third-party program review process (NEI pilot) program, and adequately prepared employees (strong base of potential workers).

Employees' Skills Meet Employers' Needs

One of the key intents of the Energy Production Technology program is to prepare students to enter the workforce in an energy production area while also increasing the skills of those already in the workforce. In order to continue to meet these employer needs, as the program matures, it is important to sustain a feedback continuum in order to maintain program relevancy. For example, at the early stages of program development, based on feedback from employers and students, a key component missing from the program that limited students' preparedness was that the college did not have lab equipment or a recognized lab space for one of the hands-on technical programs. Gaps were identified through instructor and student surveys that revealed this limited access to equipment. Initially, to use appropriate equipment, instructors would either schedule time at the plant or bring pieces to the class for students to use. This, at times, caused logistical issues for both students and the instructors.

METHODS AND PROCEDURES

Three research questions formed the basis for this study to examine issues surrounding the Energy Production Technology program. The intent was to: (1) determine the perceptions of the advisory committee participants regarding their role with the program including questions about curriculum, equipment, facilities, and job placement; (2) understand the perceptions of employers regarding how the college program prepared students for employment in the energy field; and (3) ascertain program graduates' perceptions about how the college program readied them for employment in the energy field and to provide a reflection of their scholastic experience at the college.

This research used a mixed method, case study approach as the strategy of inquiry. Characterized by its exploratory nature, this type of research seeks a more in-depth, detailed, and close-up view of a topic, collecting data with questions that typically begin with "how" or "what" (Creswell, 1998) and expressing data using words rather than numbers. The method provides 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). Additionally, online surveys were used to understand the perceptions of the program graduates. Data was analyzed and organized into themes and patterns consistent with the conceptual framework.

Selection of Subjects

Purposeful sampling is a technique widely used in mixed methods research for the identification and selection of information-rich cases for the most effective use of limited resources (Patton 2002). This involves identifying and selecting individuals or groups of individuals who are especially knowledgeable about, or experienced with, a phenomenon of interest (Creswell & Plano Clark, 2010). The population in the study included individuals (students, advisory committee members, and energy employers) who were currently participating in, or who had recently participated in, the college's EPT program, as noted below:

> **Group One:** Former and current advisory committee members (2008-present) who helped establish and continue oversight of the program. (N = 7; interview)
>
> **Group Two:** Energy production employers who have hired graduates from the program. (N = 4; interview, skills checklist)
>
> **Group Three:** Students who had graduated from the EPT during the life of the program (2008-present). (N = 34; survey)

Personal interviews were conducted with group one, the seven individuals who had or still continue to participate in the advisory committee, to capture their perceptions of the program development and implementation. To address research question number one, advisory committee participants were asked their perceptions regarding their role with the program, including questions about curriculum, equipment, facilities, and job placement.

Personal interviews were also conducted with group two, the four individuals at the power plants who have hired graduates from the college's energy program. To address research question number two, these participants were asked their perceptions about how the college program prepared students for employment in the energy field. Included as part of the interview process, these individuals were also asked to complete a skills checklist that examined the specific skill sets of the graduates they have hired.

An online survey was developed to understand the perceptions of the students who graduated from the program (group three). To address research question number three, program participants were asked their perceptions about how the college program readied them for employment in the energy field and to provide a reflection of their scholastic experience at the college. Based on graduation data received from college records, 125 potential program graduates were available for the survey. An email request was sent out, as well as follow-up reminders, which yielded 34 participants out of 115 (10 addresses were undeliverable) for a 30% response rate. Descriptive statistics were used to summarize and analyze the survey data.

Once all data was sorted and reviewed, patterns began to materialize. A theme such as "nuclear culture" for example, was created to facilitate additional layers of complex analysis. The interpretation of data also required a basic understanding of human behavior as it was important to interpret each individual's explanation. Additional analysis was completed in order to have the interview evidence validated. "In qualitative research, validation has focused on assessing how well participants' meanings have been captured and interpreted" (Ritchie & Lewis, 2013, p. 358). This method is known as respondent validation (or member checking), which involved returning to the study participants of both Groups One and Two and asking them to validate the analyses (Burnard, Gill, Stewart, Treasure, & Chadwick, 2008, para. 19). The interview subjects were provided transcripts of the interview and asked to review the account as deduced by the researcher, to make sure their narrative was accurately applied.

FINDINGS

While reviewing the interview transcripts, common statements or expressions that appeared to be connected to the research questions were highlighted, coded, and grouped into themes using the reduction process. For example, statements that were coded as "developing a local hiring pool" were grouped with other significant topics coded as "lack of trained individuals," "entry-level candidates," and "looking for employable people" into a larger theme coded as "creating a qualified workforce." Each significant point from the transcripts of the employers and the advisory committee were coded using a similar framework as the example listed above. Through the raw data collected from the employers three themes emerged, whereas the advisory committee interviews fostered four themes. In reporting the findings, names and other identifying factors of the subjects have been restricted; if a name was needed to improve readability, a pseudonym or alias was used.

Research Question One

During the interview process, study participants were asked to reflect on their experiences as an advisory committee member, why they felt it was important to participate in the program, describe the NUCP feedback loop, describe the impact to the workforce, provide lessons learned and reflect on significant experiences. Analysis of the interview data provided dominant themes that participants viewed as significant factors regarding their participation in the program's advisory committee as described below.

Theme one: Program has created qualified workers. Based on the perspective of developing competent workers coupled with the perceptions of mass retirements, the advisory committee commented favorably that the college did indeed offer a supply of qualified technicians with at least 45 of the 125 program graduates presently employed in the local energy industry. According to Stanley (subject 2, personal interview, July 6, 2015), a college representative, "I think it's been huge. I mean look at the number of graduates who are working at the local plants . . . before this program, we had nothing."

Theme two: Be sure to involve the right stakeholders. Despite getting key stakeholders on the advisory board, not having the right person from all levels within the industry did impact the effectiveness of the feedback loop for the NUCP process among the committee, employer, and student. Mark (subject 3, personal interview, July 7, 2015) for example stated that, "Feedback wise, to be honest, I really wish we would add more stake from a management level... it seemed like there was a lot of in-between that lacked getting information from a real stakeholder." In other words, based on this feedback, because of the lack of stakeholder involvement regarding student results, some outcomes were not addressed, and it sometimes hurt the reputation of the program.

Theme three: Program not adequately preparing graduates to pass the pre-employment test. The nuclear energy industry utilizes pre-employment testing on certain jobs to identify and assess a candidate's abilities and skills. When the program was first developed, the concept of pre-employment testing was not an issue strongly discussed by the advisory committee--it was an afterthought. Also, students were vaguely aware of the process, and the curriculum was not developed so they could easily transition into successful pre-employment exams; therefore, many students were not prepared for such tests. This was a consistent concern among all three groups (students, employers, and advisory committee). Larry (subject 1, personal interview, July 1, 2015) felt quite strongly regarding this as he stated that, "The biggest gap that I saw for the entire time I was there, and I would be surprised if it's not still a gap today, was the mathematics to prepare the students for the MASS/POSS test" (the pre-employment exam).

Theme four: Need a better understanding of balance between labor supply and demand. During the development process the college faced significant challenges to help "create a market"—that is, to not simply harvest a supply of degrees, but to also influence the demand for those degrees. Another concern was that "labor demand" included some positions that did not require a degree and therefore inflated the plants' estimates of the number of new hires needed. Founded on the lack of a more in-depth environmental scan and needs analysis, it was better understood that it was probably irresponsible to let the program increase to 230 students. Larry (pseudonym) suggested that:

> My biggest advice is to watch your numbers. We kind of were told that by some people up front. In retrospect we probably should pay more attention to that. Watch the numbers based on the demand in the local community and basically put a cap on the number of people that are in the program.

Based on the disappointment from those that could not find employment in the industry, making sure to have the right balance of labor supply and demand is critical.

Research Question Two

During the interview process, employers who hired the graduates were asked to reflect on whether the EPT program prepared students for a career in the energy industry, how they compared to other school's graduates, what skills they were best or least equipped with, and what additional advice they could provide to the college to help strengthen the program. Analysis of the interview data provided dominant themes that participants viewed as significant factors regarding the college's program preparing students for employment in the energy field.

Theme one: Students are well prepared on core technical skills. Based on both the interview responses and the replies to the skills checklist, employers from each plant agreed that EPT graduates have the core technical skills necessary to work in the energy industry. Evan (subject 4, personal interview, July 30, 2015) from Plant A stated, "They're good at what they do. They came into the training class here from the courses and I think that gave them a good leg-up for the next level. The plant specific, system specific things."

Theme two: Individuals from the military are better prepared. When asked how EPT graduates from the college compare to those graduates from other technical programs (military other colleges), all respondents collectively stated that the people in the military had an advantage. A key theme that should be pointed out from these statements is that "it isn't because of the schooling," it is ingrained in the military recruits because it has been their job.

Theme three: The program should better prepare students for the "nuclear culture."
In Table 1 of the skills checklist response, employers of EPT graduates moderately agreed that graduates were prepared. However, what the skills checklist did not identify that what the interviews included was the concept of preparedness for an employee in the nuclear field. When asked about some shortcomings of EPT graduates, Evan (pseudonym) stated," Probably just the difference in our industry and how we do business. We have very strict guidelines on how to work through [any] procedure" (in the nuclear environment).

Employers filled out a skills' checklist based on a review of the program's guidelines regarding the students' preparedness. Tables 1-3 display the respondents' answers to questions regarding graduates' skills preparedness, core fundamentals preparedness, and overall preparedness. The total mean scores in Table 1 ranged from 4.50 – 5.50. Overall the employers moderately agreed that the graduates had the necessary core skills. It should be noted that the lower standard deviation (SD) would generally mean that there was significant alignment among the respondents' answers; however, the small number of individuals interviewed (n = 4) drastically affects the confidence interval of this data.

The mean scores for Nuclear Uniform Curriculum Program (NUCP) core fundamentals preparedness (see Table 2) were above the mid-point, with a range of 4.00 – 5.25. The highest skill score was "Computers (plant specific)," and the lowest was a tie among three topics: "Electrical Sciences," "Heat Transfer and Fluid Flow" and "Chemistry." All four supervisors scored these topics equally.

On the skills checklist, question 3 asked about overall preparedness. The total mean score on this topic was 5.25, which indicates moderate agreement (Table 3).

To summarize the responses to research question number 2, overall the four employer respondents believed that graduates of an Energy Production Technology program were prepared for employment. They did believe the graduates could use some work being prepared for the nuclear culture, an area in which they believed military recruits had an obvious advantage.

Research Question Three
The third research question sought perceptions from the energy program's graduates regarding how the college program readied them for employment in the energy field, and to provide a reflection of their scholastic experience at the college. A survey tool based on a review of program guidelines was used to gather

Table 1: *Employers' Perceptions of Graduate Skills Preparedness*

Question	Disagree Strongly n (%)	Disagree Moderately n (%)	Disagree Slightly n (%)	Agree Slightly n (%)	Agree Moderately n(%)	Agree Strongly n (%)	Mean	SD
Overall, program prepared graduates hired for these job skills:								
Successfully demonstrate safe work habits	0(0.0)	0(0.0)	0(0.0)	0(0.0)	4(100.0)	0(0.0)	5.00	0.00
Successfully work in teams	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(50.0)	2(50.0)	5.50	0.50
Successfully work independently	0(0.0)	0(0.0)	0(0.0)	1(25.0)	2(50.0)	1(25.0)	5.00	0.71
Successfully solve complex problems	0(0.0)	0(0.0)	0(0.0)	2(50.0)	2(50.0)	0(0.0)	4.50	0.50
Document clearly and effectively	0(0.0)	0(0.0)	0(0.0)	2(50.0)	2(50.0)	0(0.0)	4.50	0.50
Communicate clearly and effectively	0(0.0)	0(0.0)	0(0.0)	1(25.0)	2(50.0)	1(25.0)	5.00	0.71

Note. Likert Scale = Disagree Strongly (1), Disagree Moderately (2), Disagree Slightly (3), Agree Slightly (4), Agree Moderately (5), Agree Strongly (6).

Table 2: *Employers' Perceptions of Nuclear Uniform Curriculum Program (NUCP) Core Fundamentals Preparedness*

Question	Disagree Strongly n (%)	Disagree Moderately n (%)	Disagree Slightly n (%)	Agree Slightly n (%)	Agree Moderately n(%)	Agree Strongly n (%)	Mean	SD
Overall, program successfully prepared graduates with these NUCP core fundamentals:								
Mathematics	0(0.0)	0(0.0)	0(0.0)	1(25.0)	3(75.0)	0(0.0)	4.75	0.43
Physics	0(0.0)	0(0.0)	0(0.0)	3(75.0)	1(25.0)	0(0.0)	4.25	0.43
Electrical Sciences	0(0.0)	0(0.0)	0(0.0)	4(100.0)	0(0.0)	0(0.0)	4.00	0.00
Basic Atomic and Nuclear Physics	0(0.0)	0(0.0)	0(0.0)	2(50.0)	2(50.0)	0(0.0)	4.50	0.50
Heat Transfer and Fluid Flow	0(0.0)	0(0.0)	0(0.0)	4(100.0)	0(0.0)	0(0.0)	4.00	0.00
Chemistry	0(0.0)	0(0.0)	0(0.0)	4(100.0)	0(0.0)	0(0.0)	4.00	0.00
Properties of Reactor Plant Materials	0(0.0)	0(0.0)	0(0.0)	3(75.0)	1(25.0)	0(0.0)	4.25	0.43
Radiation Detection and Protection	0(0.0)	0(0.0)	0(0.0)	1(25.0)	3(75.0)	0(0.0)	4.75	0.43
Reactor Plant Protection and Safety	0(0.0)	0(0.0)	0(0.0)	2(50.0)	2(50.0)	0(0.0)	4.50	0.50
Computers (Plant Specific)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(75.0)	1(25.0)	5.25	0.43
Basic Systems Knowledge	0(0.0)	0(0.0)	0(0.0)	2(50.0)	2(50.0)	0(0.0)	4.50	0.50
Basic Components Knowledge	0(0.0)	0(0.0)	0(0.0)	2(50.0)	2(50.0)	0(0.0)	4.50	0.50

Note. Likert Scale = Disagree Strongly (1), Disagree Moderately (2), Disagree Slightly (3), Agree Slightly (4), Agree Moderately (5), Agree Strongly (6).

Table 3: *Employers' Perceptions of Students' Overall Preparedness*

Question	Disagree Strongly n (%)	Disagree Moderately n (%)	Disagree Slightly n (%)	Agree Slightly n (%)	Agree Moderately n(%)	Agree Strongly n (%)	Mean	SD
Overall, the Energy Production Technology Program has:								
Successfully prepared the graduates I have hired for a career in the energy industry	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(75.0)	1(25.0)	5.25	0.43

Note. Likert Scale = Disagree Strongly (1), Disagree Moderately (2), Disagree Slightly (3), Agree Slightly (4), Agree Moderately (5), Agree Strongly (6).

Table 4: *Students' Perceptions of Instructional Content and Program Quality*

Question 3	Employed Y or N	Disagree Strongly n (%)	Disagree Moderately n (%)	Disagree Slightly n (%)	Agree Slightly n (%)	Agree Moderately n(%)	Agree Strongly n (%)	Mean	SD
Instructional content and quality program were to provide me with strong practical job application experience.									
	Yes (n=18)	0(0.0)	1(5.5)	1(5.5)	0(0.0)	8(44.4)	8(44.4)	5.17	1.07
	No (n=16)	2(12.5)	1(6.3)	2(12.5)	1(6.3)	8(50.0)	2(12.5)	4.13	1.58
	Tot. (n=34)	2(5.9)	2(5.9)	3(8.8)	1(2.9)	16(47.1)	10(29.4)	4.68	1.43

Note. Likert Scale = Disagree Strongly (1), Disagree Moderately (2), Disagree Slightly (3), Agree Slightly (4), Agree Moderately (5), Agree Strongly (6).

Table 5: *Students' Perceptions of Job Skills Preparedness*

Question 3	Employed Y or N	Disagree Strongly n (%)	Disagree Moderately n (%)	Disagree Slightly n (%)	Agree Slightly n (%)	Agree Moderately n(%)	Agree Strongly n (%)	Mean	SD
Overall, program prepared me for the job skills:									
Successfully demonstrate safe work habits	Yes (n=18)	0(0.0)	0(0.0)	2(11.1)	5(27.8)	4(22.2)	7(38.9)	4.89	1.05
	No (n=16)	0(0.0)	0(0.0)	2(12.5)	3(18.8)	4(25.0)	7(43.8)	5.00	1.06
	Tot. (n=34)	0(0.0)	0(0.0)	4(11.8)	8(23.5)	8(23.5)	14(41.5)	4.94	1.06
Successfully work in teams	Yes (n=18)	0(0.0)	0(0.0)	1(5.6)	3(16.7)	3(16.8)	11(68.8)	5.33	0.94
	No (n=16)	0(0.0)	0(0.0)	3(18.8)	2(12.5)	4(25.0)	7(43.8)	4.94	1.14
	Tot. (n=34)	0(0.0)	0(0.0)	4(11.8)	5(14.7)	7(20.6)	18(52.9)	5.15	1.06
Successfully work independently	Yes (n=18)	0(0.0)	0(0.0)	1(5.6)	3(16.7)	5(31.3)	9(56.3)	5.22	0.92
	No (n=16)	0(0.0)	0(0.0)	3(18.8)	2(12.5)	4(25.0)	7(43.8)	4.94	1.14
	Tot. (n=34)	0(0.0)	0(0.0)	4(11.8)	5(14.7)	9(26.5)	16(47.1)	5.09	1.04
Successfully solve complex problems	Yes (n=18)	0(0.0)	0(0.0)	1(5.6)	4(22.2)	5(27.8)	8(44.4)	5.11	0.94
	No (n=16)	1(6.3)	0(0.0)	2(12.5)	2(12.5)	4(25.0)	7(43.8)	4.81	1.42
	Tot. (n=34)	1(2.9)	0(0.0)	3(8.8)	6(17.7)	9(26.5)	15(44.1)	4.97	1.20
Document clearly and effectively	Yes (n=18)	0(0.0)	0(0.0)	2(11.1)	3(16.8)	6(33.3)	7(38.9)	5.00	1.00
	No (n=16)	1(6.3)	1(6.3)	2(12.5)	1(6.25)	4(25.0)	7(43.8)	4.69	1.57
	Tot. (n=34)	1(2.9)	1(2.9)	4(11.8)	4(11.8)	10(29.4)	14(41.1)	4.85	1.31
Communicate clearly and effectively	Yes (n=18)	0(0.0)	1(5.6)	1(5.6)	2(11.1)	7(38.9)	7(38.9)	5.00	1.11
	No (n=16)	1(6.3)	0(0.0)	2(12.5)	2(12.5)	3(18.8)	8(50.0)	4.88	1.45
	Tot. (n=34)	1(2.9)	1(2.9)	3(8.8)	4(11.8)	10(29.4)	15(44.1)	4.94	1.28

Note. Likert Scale = Disagree Strongly (1), Disagree Moderately (2), Disagree Slightly (3), Agree Slightly (4), Agree Moderately (5), Agree Strongly (6).

information about graduates' perceptions both in school and if applicable, at subsequent employment, regarding if they believed they were prepared for employment. It was important to investigate what this new program's experience meant to the participants, and to determine what they believed to be the strengths and weaknesses of the program, based on both their perceptions of their experience and ability to be employed. The survey was comprised of 20 questions using a six-point Likert scale, and it included three open-ended questions regarding their perceptions of the program.

For question 3 of the survey, respondents were asked about *instructional content and program quality.* The results presented in Table 4, are broken down by those employed in the industry, those not employed in the industry, and the overall total.

The total mean score regarding instructional content and program quality was moderately high at 4.68. Over 78% of the students moderately agreed that the curriculum was designed to provide them with strong, practical job application experience. This number is based on an average that included students who stated they were working in the energy industry and those who were not. For students with jobs (N = 18) in the energy field, 89% of them felt the program content and quality was solid, whereas for students without such jobs (N = 16) 69% agreed. It is important to note that a pattern was revealed throughout this survey that the mean scores from students who did not attain a position in the energy field was much lower on average than students who did gain a position, and this lowers the total mean substantially. The mean scores regarding instructional content and program quality came in at 5.71 for student with jobs in the energy field and 4.13 for students who did not gain employment in this field. However the sample size is not large enough to establish statistical significance.

The mean scores regarding job skills preparedness in Table 5 were quite high with a range of 4.85 – 5.15. The highest skill score was "successfully work in teams" and the lowest was "document clearly and effectively": all other statements had a mean score over 4.8. More than 87% of the students felt that they had the appropriate job skills to work in the energy field. Significantly, even the students who did not have jobs in the energy field still felt very prepared by the program to work in energy by an average of 81%.

The mean scores for Nuclear Uniform Curriculum Program (NUCP) core fundamentals preparedness were above average with a range of 4.26 – 5.44. The highest skill score was "properties of reactor plant materials," and the lowest was

Table 6: *Perceptions of Nuclear Uniform Curriculum Program (NUCP) Core Fundamentals Preparedness*

Question 3	Employed Y or N	Disagree Strongly n (%)	Disagree Moderately n (%)	Disagree Slightly n (%)	Agree Slightly n (%)	Agree Moderately n(%)	Agree Strongly n (%)	Mean	SD
Overall, program prepared me to meet these Nuclear Uniform Curriculum Program (NUCP) core fundamentals:									
Mathematics	Yes (n=18)	0(0.0)	0(0.0)	1(5.9)	1(5.9)	6(33.3)	9(50.0)	5.28	0.87
	No (n=16)	1(6.3)	1(6.3)	2(12.5)	2(12.5)	6(37.5)	4(25.0)	4.44	1.46
	Tot. (n=34)	1(2.9)	1(2.9)	3(8.8)	3(11.8)	12(35.3)	13(38.2)	4.88	1.25
Physics	Yes (n=18)	0(0.0)	0(0.0)	0(0.0)	4(22.2)	4(22.2	10(55.6)	5.33	.082
	No (n=16)	0(0.0)	2(12.5)	1(6.3)	3(18.8)	6(37.5)	4(25.0)	4.56	1.27
	Tot. (n=34)	0(0.0)	2(5.9)	1(2.9)	7(20.6)	10(29.4)	14(41.2)	4.97	1.12
Electrical Sciences	Yes (n=18)	0(0.0)	0(0.0)	1(5.56)	4(22.2)	6(33.3)	7(38.4)	5.06	0.91
	No (n=16)	1(6.3)	2(12.5)	0(0.0)	5(31.3)	4(25.0)	4(25.0)	4.31	1.49
	Tot. (n=34)	1(2.9)	2(5.9)	1(2.9)	9(20.6)	10(29.4)	11(41.2)	4.71	1.27

Note. Likert Scale = Disagree Strongly (1), Disagree Moderately (2), Disagree Slightly (3), Agree Slightly (4), Agree Moderately (5), Agree Strongly (6).

Table 6 continued: *Perceptions of Nuclear Uniform Curriculum Program (NUCP) Core Fundamentals Preparedness*

Question 3	Employed Y or N	Disagree Strongly n (%)	Disagree Moderately n (%)	Disagree Slightly n (%)	Agree Slightly n (%)	Agree Moderately n(%)	Agree Strongly n (%)	Mean	SD
Overall, program prepared me to meet these Nuclear Uniform Curriculum Program (NUCP) core fundamentals:									
Basic Atomic and Nuclear Physics	Yes (n=18)	0(0.0)	0(0.0)	0(0.0)	3(16.7)	3(16.7)	12(66.7)	5.50	.076
	No (n=16)	1(6.3)	0(0.0)	1(6.3)	2(12.5)	6(37.5)	6(37.5)	4.88	1.32
	Tot. (n=34)	1(2.9)	0(0.0)	1(2.9)	5(14.7)	9(29.4)	18(51.5)	5.21	1.11
Heat Transfer and Fluid Flow	Yes (n=18)	1(5.6)	0(0.0)	0(0.0)	4(22.2)	6(33.3)	7(38.4)	4.94	1.23
	No (n=16)	2(12.5)	0(0.0)	0(0.0)	3(18.8)	7(43.8)	4(25.0)	4.56	1.50
	Tot. (n=34)	3(8.8)	0(0.0)	0(0.0)	7(20.6)	13(38.2)	11(32.4)	4.76	1.37
Chemistry	Yes (n=18)	0(0.0)	0(0.0)	0(0.0)	5(27.8)	4(22.2)	9(50.0)	5.22	0.85
	No (n=16)	3(18.8)	1(6.3)	2(12.5)	2(6.3)	6(37.5)	2(12.5)	3.81	1.70
	Tot. (n=34)	3(8.8)	1(2.9)	2(5.9)	7(20.6)	10(29.4)	11(32.4)	4.56	1.50
Properties of Reactor Plant Materials	Yes (n=18)	0(0.0)	0(0.0)	0(0.0)	2(11.1)	2(11.1)	14(77.9)	5.67	0.67
	No (n=16)	0(0.0)	1(6.3)	0(0.0)	2(12.5)	5(31.3)	8(50.0)	5.19	1.07
	Tot. (n=34)	0(0.0)	1(2.9)	0(0.0)	4(11.8)	7(20.6)	22(64.7)	5.44	0.91
Radiation Detection and Protection	Yes (n=18)	0(0.0)	0(0.0)	2(11.1)	4(22.2)	2(11.1)	10(55.6)	5.11	1.10
	No (n=16)	1(6.3)	0(0.0)	0(0.0)	3(18.8)	5(31.3)	7(43.8)	5.00	1.27
	Tot. (n=34)	1(2.9)	0(0.0)	2(5.9)	7(20.6)	7(20.6)	17(50.0)	5.06	1.19
Reactor Plant Protection and Safety	Yes (n=18)	0(0.0)	1(5.6)	0(0.0)	3(16.7)	3(16.7)	11(61.1)	5.28	1.10
	No (n=16)	0(0.0)	1(6.3)	1(6.3)	0(0.0)	5(31.3)	9(56.3)	5.25	1.15
	Tot. (n=34)	0(0.0)	2(5.9)	1(2.9)	3(8.8)	8(23.5)	20(58.8)	5.26	1.12
Computers (plant specific)	Yes (n=18)	0(0.0)	0(0.0)	3(16.7)	6(33.3)	5(27.8)	4(22.2)	4.56	1.01
	No (n=16)	1(6.3)	3(18.8)	2(12.5)	3(18.8)	4(25.0)	3(18.8)	3.94	1.56
	Tot. (n=34)	1(2.9)	3(8.8)	5(14.7)	9(26.5)	9(26.5)	7(24.2)	4.26	1.34
Basic Systems Knowledge	Yes (n=18)	0(0.0)	1(5.6)	0(0.0)	1(5,6)	4(22.2)	12(66.7)	5.44	1.01
	No (n=16)	0(0.0)	0(0.0)	0(0.0)	2(2.9)	9(56.5)	5(31.3)	5.19	0.63
	Tot. (n=34)	0(0.0)	1(2.9)	0(0.0)	3(8.8)	13(38.2)	17(50.0)	5.32	.087
Basic Components Knowledge	Yes (n=18)	0(0.0)	0(0.0)	2(11.1)	1(5.6)	4(22.2)	11(61.1)	5.33	1.00
	No (n=16)	0(0.0)	0(0.0)	0(0.0)	2(12.5)	8(50.0)	6(37.5)	5.25	.066
	Tot. (n=34)	0(0.0)	0(0.0)	2(5.9)	3(8.8)	12(35.3)	17(47.1)	5.29	.086

Note. Likert Scale = Disagree Strongly (1), Disagree Moderately (2), Disagree Slightly (3), Agree Slightly (4), Agree Moderately (5), Agree Strongly (6).

Table 7:

Question	Mean	SD
Teaching methods, procedures, and course content program were:		
A. very pertinent to my major.	4.32	0.79
B. very current and meaningful to me.	4.18	0.95
Related and support courses were:		
A. very pertinent to my major.	4.74	1.01
B. very current and meaningful to me.	4.65	1.16
The work experience aspect of the program was:		
A. readily available at convenient locations.	4.18	1.84
B. readily available at convenient times of day.	4.18	1.75
Career planning information provided by college:		
A. successfully met my needs and interests.	3.76	1.71
B. successfully helped me plan my program.	4.00	1.71
Job success information on former graduates:		
A. successfully helped me make career decisions.	3.31	1.63
B. clearly conveyed job opportunities available via this occupation.	3.58	1.60
Placement services at college:		
A. successfully helped me find employment opportunities.	3.26	1.87
B. prepared me well to apply for a job.	3.62	1.68
Occupational instructors:		
A. knew the subject matter and occupational requirements well.	5.65	1.59
B. were always available to provide help when I needed it.	5.21	1.93
Instructional support services (such as tutoring, lab assistance) :		
A. always available to meet my needs and interests.	4.26	1.24
B. always provided by knowledgeable interested staff	4.41	1.35
Instructional lecture and laboratory facilities:		
A. always provided adequate lighting, ventilation, heating, power and other utilities.	5.55	0.74
B. always included enough work stations for # of students enrolled.	5.39	1.01
Instructional equipment:		
A. always current and representative of the industry.	5.06	1.10
B. always in sufficient quantity to avoid long delays in use.	5.06	1.07
Instructional materials (e.g., textbooks, reference books, supplies):		
A. always available and conveniently located for use as needed.	5.09	1.04
B. always current and meaningful to the subject.	4.97	1.29

"computers (plant specific)." Chemistry, item 16F, was the only topic in this area that stood out as substantially different between those employed in the energy field and those who were not, with a mean difference of 1.41 points.

Other questions on the survey asked about various components of the program, such as the instructors, facilities, and career services; these are summarized in Table 7. Some of the highest ranked items were instructors' knowledge of subject matter and instructional facilities; some of the lowest ranked items were job information and employment services.

DISCUSSION

This study investigated the concerns, ideas, and recommendations for understanding current practices or sustaining those that best meet the needs of the stakeholders regarding development and implementation of the Energy Production Technology program. It was essential to assess the feedback process within this partnership to determine if the program was yielding effective results as perceived by program graduates and their employers. Equally important was to determine the role played by the advisory committee that was developed to implement and provide oversight to the program.

What the findings of this study brought to light was that, through the guidance of the advisory committee, the college developed a program supported by the NUCP and the outcome was qualified graduates. Also evident was that the feedback loop generally worked well, but there were times when it did not always happen and issues went unresolved. For example, feedback was seldom provided by the plants to determine how the program graduates were performing on the job. Based on this, a key update to the conceptual framework would be to develop checks and balances to the feedback process by incorporating more intentional opportunities for feedback, such as holding monthly outreach sessions with employers. It is unfortunate that, although the graduates were qualified, there were not enough positions available at the plants for all who were eligible.

To summarize research question one, the program was successful for creating a qualified workforce. The interviews for the study also served as a reflection and summary of the key events for the advisory committee during the program development. The following important points that surfaced during the actual study: making sure the college has the right stakeholders; making sure that the students are better prepared for the nuclear culture, which includes the entrance exams and an understanding of the market necessary for a right-sized student population. A key addition to the literature would be research how the findings in this study corroborate with key principles from experts (like the importance of nuclear culture, stakeholders and labor demand) in the OECD and MPR reports cited.

The second research question sought information from individuals who have employed graduates from the college's energy program regarding their perceptions about how the college program prepared students for employment in the energy field. Employers were also asked to complete a skills' checklist on the graduates they hired. The power plant employers believed that EPT graduates were adequately prepared for employment, although they felt that the military recruits were better prepared based on the culture in which they work. This was viewed as a shortcoming for graduates at the onset of their employment, but employers stated that EPT graduates did catch up with their military colleagues as they spent more time in the nuclear culture. The contrast between the two groups was not anticipated by the advisory committee but was obvious to the employers when asked.

To summarize research question three, from the viewpoint of the program's graduates, the students felt they were adequately prepared for employment. However it should be noted that the study uncovered opinions that varied on several topics based on whether or not the students were employed in the energy industry. For example, almost 90% of those employed in the energy field believed they were well prepared compared to 56% of those not employed in the industry. The largest amount of feedback in the additional comments was undoubtedly the frustration some students felt regarding the lack of employment opportunities. Several students made comments regarding the inability to get a job at the local plants because they neither had a family member who worked at the plant who could possibly help them get a job or they did not have previous time in the Navy. In terms of adding to the research, surveying the graduates fills a present gap in the body of literature, because this is the first known NUCP program evaluation that collected data from all major stakeholder groups.

Several recommendations for further research have surfaced as a result of this study. First, it could be valuable to replicate the program evaluation to include participants at multiple power plants across the country, which would allow for comparison data to be used by the nuclear oversight committees enabling them to gage the perceptions of programming currently provided by community colleges. The second recommendation is to replicate the study to include all students that have taken courses in the energy program that have attained a position in the energy field; because only program graduates were surveyed in this study, some data opportunities were missed that would have increased the sample size substantially. The final recommendation is to evaluate the success of mock entrance exams. There is not presently any research that evaluates how studying with a practice test helps students be successful on passing the entrance examination tests at the power plants. It may be effective to include this process in the curriculum and implement it at other community colleges, and such a test would likely increase the students' pass rate.

This study affects policy and practice in career and technical education (CTE) by continuing to support the current practice of linking CTE education to a third-party certified curriculum. In order to receive Perkins grant funds, the Carl D. Perkins Career and Technical Education Act of 2006 requires that CTE programs are aligned, if possible, with third-party assessments, in this case the NUCP standards. The study also demonstrated that expectations from an advisory committee are important to an occupational program, and also speaks to how prospective programs should have both a thorough needs analysis and periodic program evaluations, including a survey of graduates. A final lesson learned is that developing a new technical program involves much more than simply having the right technology.

CONCLUSION

This study was initiated to find out how the EPT program at one Midwest community college successfully prepared graduates for a career in the energy industry.

From the viewpoint of the business and industry advisory committee created to oversee the Energy Production Technology degree program:

- The program was successful for creating a qualified workforce
- It is necessary to understand the job market and the culture, and it is important to retain the key players involved for decision making.

From the viewpoint of the power plant employer:

- Program graduates were adequately prepared for employment.
- There was a need to continually provide field experience and job shadowing opportunities to help students strengthen their awareness in the nuclear field.
- There was a need to create a stronger feedback loop within the program oversight process to help both the college and plant to continue a robust relationship.

From the viewpoint of the program's graduates:

- Students felt they were adequately prepared for employment.
- It is important to balance the job supply with the demand.

Dr. Kenneth Flowers, *is the Dean of Career and Workforce Education at Lake Michigan College, Benton Harbor, Michigan.*

Dr. Richard Zinser *is a Professor in the Career and Technical Education Division at Western Michigan University, Kalamazoo.*

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