Introduction

Typically, higher education is the venue for developing and refining a food science curriculum. Food science degree programs in higher education have conducted research, produced innovative courses, and developed curricula to align with standards established by the Inst. of Food Technologists (IFT) (Hood and others 2002; Patil and others 2003; Willard and Duffrin 2003). Research and anecdotal evidence suggest that knowledge benchmarks have been established for food science programs in higher education (Hartel 2002); however, opportunities exist to develop a food science curriculum for future non-degreed front-line employees being schooled at career and technical education (CTE) centers. This article describes the outcomes of a needs assessment concerning current training needs and performance targets for non-degreed employees in the food industry. Moreover, the authors suggest broader implications for CTE food science curricula.

Workforce Composition

Many of the front-line workers within the food industry are non-degreed high school graduates. More than half of all workers in the food industry are in the production environment as front-line supervisors, managers of production and operation, bakers, slaughterers and meat packers, food batch makers, inspectors, testers, sorters, and samplers (BLS 2004). In addition, other non-degreed employees occupy positions in the transportation sector (moving materials) and in service occupations (fast food and counter workers) (BLS 2004). Although these employees do not necessarily need degrees in food science, they nevertheless have a direct impact on efficiency of production within a company, on quality of products produced, and in delivery of safe foods to consumers.

An example of the impact at the state and regional level is the snack industry in Pennsylvania. This particular industry, made up of many small and medium-sized companies, contributes significantly to the rural economy of the state. Specifically, Pennsylvania ranks 1st in the nation with respect to the production of snacks, including potato chips and pretzels. This industry generates more than $1.21 billion in sales annually because of a strong local supply of raw materials and proximity to major consumer markets. The bakery industry alone employs more than 17000 people in Pennsylvania, and the other food processing sectors each employ at least 5000 people. Yet, despite the importance of the industry to the agriculture,
employment, and rural economy of Pennsylvania, very little attention has been focused on aligning the competencies and knowledge of the incoming workforce with industry needs. Basic training in the concepts of food science and an awareness of the food system will likely increase employment opportunities for individuals and will enhance the productivity of employees.

The Bureau of Labor Statistics (2004) has estimated that total employment in the food manufacturing industry will increase by 4.7% by 2012. These statistics indicate that food industries are likely to continue to recruit non-degreed employees. To address the growing needs of the food industry and to create employment skills required to function and prosper in the new global economy, CTE curriculum planners, teachers, and administrators can implement strategies that are mindful of current industry needs and standards.

CTE Curriculum Opportunities

Collaborations between school districts, industry, and universities are just beginning to address some of the needs of the non-degreed population within the larger context of education. For example, Safeway Inc., in partnership with the California Polytechnic University’s Food Science and Nutrition Dept., and Arroyo Grande High School in Arroyo Grande, California, designed Introduction to the Food Industry (IFT/CEPD 2004). Written and produced as a public service to the educational community, the developers of the materials have conceived of this self-study learning tool as a way to assist high school students in their exploration of the food industry and career opportunities. IFT provides worldwide distribution of the course via its Internet web page. Introduction to the Food Industry is an excellent example of how industry, universities, and schools are collaborating to expand high school students’ interest in food science and the food industry.

The authors of this article have similarly established a collaborative, multidisciplinary partnership between Univ. faculty in food science, curriculum and instruction, and instructional systems, public school administrators, and the teachers of general food and agricultural sciences in a career and technical center (CTC). With the goal of designing, implementing, and developing general food and agricultural sciences modules for this CTC, authors obtained funding through the U.S. Dept. of Agriculture to conduct an educational needs assessment. Design and development of the needs assessment was guided by the following research question—what are industry needs with regard to knowledge, skills, and dispositions of entry-level food industry employees? In subsequent sections, we describe the design and implementation of our initial needs assessment and identify the major themes that emerged through data analysis. These themes include concerns about safety, knowledge of food systems, professional conduct, and elementary knowledge and skills. We conclude by describing future steps for research and practice.

Data Collection

To answer our research question, we used focus groups (Morgan 1997). Focus groups are useful in gathering much data from many participants in a short timeframe (Rossett 1997). The process allowed us to (1) gather views and experiences of a variety of participants, (2) gain insights into participants’ shared understandings, and (3) observe the interplay of different perspectives about the same topic during the actual interview. We conducted multiple focus groups to reach data saturation and to triangulate data (Bogan and Biklen 1992).

We identified 5 major national companies (names are changed to maintain confidentiality) that were representative of the businesses in southeast Pennsylvania: VeggieFresh, a fresh vegetable company; VeCan, a canned vegetable company; Crisps, Inc., and Snackers, 2 different snack food companies, and Meat Products Inc., a meat company (Table 1). We contacted the CEO of the companies and explained our intentions for the proposed focus group. The CEO identified the 1 specific participant each from human resource, production, quality assurance (QA), purchasing, and product development to participate in focus groups. These particular participants were chosen by the CEO because of their role within the company, their awareness of company needs and activities, and their specific knowledge of the particular skills required in a manufacturing facility. Representatives were contacted via phone between October and December 2004, and subsequently focus groups were held.

Each focus group lasted approximately 2 h, during which a semi-structured interview protocol (Merriam 1998) was used. The focus groups were conducted at the respective companies. All the participants gathered in the same room at the same time for the meeting. The focus group moderator, an expert in food science, was able to refine questions according to responses and participant expertise. The questions focused on the following issues:

- What basic knowledge and skills should food-processing employees possess?
- What knowledge and skills do current employees lack?
- What are some challenges facing the food industry today?
- What knowledge and skills will employees need to manage these challenges?

Based on participant responses, the moderator asked additional questions to clarify and elaborate understanding. Focus groups were tape-recorded, and tapes were subsequently transcribed. Focus group tapes were coded using open coding techniques suggested by Glaser and Strauss (1967). This method allows for the identification of themes and major categories based on data.

Results

The needs assessment identified 4 major themes that employers indicated as beneficial knowledge and skills for employees to possess. These themes include workplace and food safety training, food and production systems, mathematical skills, and professional conduct.

Workplace and Food Safety Training

All companies identified workplace safety and food safety train-
Food and Production Systems

Four of the five companies identified deficiencies in employee knowledge of food systems. Their understanding of food systems could be classified into 4 levels, moving from broad to specific: knowledge of food system from harvest to packaging; knowledge of flow of materials in a production line; knowledge of unit operations; and a higher level of understanding about different processes.

Knowledge of the broader food systems includes the agricultural harvest cycle, factors that affect quality of raw material at the receiving dock of the processing facility, internal company production flow, and final product quality and handling. Representatives at VeCan noted these concerns because the company encompasses agricultural as well as manufacturing processes:

“The most volatile crop we have is peas. You can lose a lot of money within a half hour of harvesting. If the operators are not ready by the time the peas get to the plant, the peas sit in the sun and they cook. So it’s a lot of coordination. Everyone really has to work closely together. How long can peas sit? Was there any dew on the peas when they were cut? What is the humidity like? Applying technical knowledge and coordinating operations is very important.”

The above example is representative of an understanding of the flow of raw material from the farm to the company. Other companies mentioned the process beyond this initial stage, including thinking forward and being aware of product movement from raw material to packaging. This includes understanding different unit operations and the constraints and relations between them. Both VeggieFresh and VeCan identified this as important qualities for employees, citing different examples.

“Someone that knows what needs to be packed in an hour or 2 down the road is thinking forward. They should think through the next 3 steps to keep the product flowing up front. Employees need to take ownership of what they’re doing and be able to think for themselves instead of having somebody always giving instructions.” (VeggieFresh)

“Very few people that come into the plant understand the agricultural business. Incoming raw material quality varies dramatically in agribusinesses. If you take an example of a potato, knowing the characteristics of the potato that will affect production, such as a defect level or size, or whatever the case may be, and to understand the limitations of the equipment to handle that.” (VeCan)

The 3rd level, an understanding of the relation between different unit operations within the production environment, is also important in ensuring product quality. This deficiency in employee knowledge was addressed by some of the companies.

“We would like the employee to understand what goes into manufacturing, for example, bologna or ham. We would like the employee to recognize defects so that they can bring that to our attention. The employees in the plant are our eyes for what is happening on the line . . . if they understand how products are manufactured it is a big help.” (Meat Products Inc.)

“Employees need to have an understanding of priorities. Knowing what needs to be checked and when, understanding what is critical, understanding how to avoid problems.” (Snackers)

The last level is related to a higher level of understanding about different processes. For example, why does flour become a dough when you add water? What are the properties of flour that affect the amount of water to be added and the final quality of the dough? It also relates to understanding specific machine operations. VeCan’s personnel addressed this level:

“Yes, employees can accomplish basic functions. Employees may know to push a certain button at a certain time, but they don’t know why they push the button.”

While this level of cognition in their employees was desired by the companies, the implementation of an education module with the context of a CTC is doubtful, as this level of content is typically delivered within Univ. food science curriculum. Further exploration will be needed to decipher how much of this knowledge can be translated or adapted to a CTC-type venue and if using real life examples would supplement the needed exposure for students. Bruner, a noted education scholar, hypothesized that “…any subject can be taught effectively in some intellectually honest form” (Bruner 1960; page 33). For example, it might be adequate to explain in lay terms what happens to flour with more or less water as it becomes a dough without explaining the chemistry of proteins and gluten.

The 4 levels identified comprise a broad range of higher order knowledge and skills, including factual knowledge, understanding and applying procedures, analyzing problems, and formulating solutions. The challenge for curriculum developers and trainers is to inculcate student with a broad understanding of food system and simultaneously encourage student to engage in problem solving with specific attention to production systems.

Mathematical Skills

All company representatives identified a need for employees to enter with mathematical skills, understanding volume, proportions, percentages, measurements, net weights, and so forth. The dominant theme was employee inability to apply basic mathematical knowledge to specific operations, even when supplied with instructions; for example, a Crisps representative noted a specific example:

“The employee did not know the difference between grams and pounds. Instead of adding the flavor concentrate in grams, he added the concentrate in pounds. So we only had a few pounds to run that particular day and we used it all up within the 1st half hour.” (Crisps, Inc.)
“Percentages give employees big problems. Let’s say the formula is based on 4000 pounds and all of a sudden it’s 4200 pounds of meat, they don’t have clue how to convert for that extra 200 pounds. I have to do that for them. Ingredients in parts per million or billion give even my lab people fits.” (Meat Products Inc.)

These examples indicate the importance of basic mathematical skills. Specifically, these quotes indicate the need to engage students in practical mathematical applications and in problem solving. While basic math skills are typically taught at the high school level, what the above observations suggest is the need to develop educational modules that more specifically provide a contextual or practical application of the principles of math.

Professional Skills

Apart from technical knowledge and skills that directly impact day-to-day operations, all companies mentioned a need for employees to have professional skills, including technological competence, cultural awareness, and work ethics. Technological competence included the ability to work with computers and various software packages, including word processing, spreadsheets, and specific technical formulation software. All companies identified 2 categories of computer-based literacy. The 1st related to more general computer skills as identified in the following quote from a Ve-Can representative.

“People have to learn to use some basic kinds of equipment and instruments in the plant. Most instruments are computerized, which can be seen as a problem or an opportunity, however you look at it. So there are a lot of things where they need computer skills . . .”

The 2nd type of competence related to specific job-related computer skills, as identified by a Meat Products, Inc. representatives: “ . . . coming into quality control, they better know Excel, work sheets, and Word. There are many icons on our screen . . . all of our labels are all computerized. There are probes that give you real time data, which is great, but employees have to know what to do with that.”

There was awareness among the companies that the younger generation employees were more familiar with the use of computers, specifically as it related to the use of spreadsheet and text-based software. However, they emphasized that the necessary translation between getting data generated by the computers in the processing line and understanding the importance or relevance of the data, was lacking.

Cultural awareness was related to rising turnover rates and the influx of new populations of workers, including increased numbers of women and immigrants. The census data projects that the race/ethnic group adding the largest number of people to the population would be the Hispanic-origin population. In fact, after 2020, the Hispanic population is projected to add more people to the United States every year than would all other race/ethnic groups combined (Day 1996). Dealing with diverse populations includes basic challenges of language barriers, which was identified as a concern by all companies and these cultural issues impact how supervisors must interact with employees. All examples cited by the companies highlighted management related issues. However, because of the interactions and interplay among and between workers on the production floor, it is important that workers have an awareness of diversity and multicultural issues. These issues can be further explored within CTC curriculum through creative interjection in light of changing workforce environments. In fact, the Inst. of Food Technologists’ Committee for Undergraduate Education Standards has recognized and identified this need (IFT 2001). They stipulate that students graduating with an undergraduate degree in food science should have the ability to “work and/or interact with individuals from diverse cul-

tures” and “commit to the highest standards of professional integrity and ethical values.”

Issues related to a diverse workforce also raise the need for channels of communication between management and employee and among employee peer groups. One company, VeggieFresh, is proactive in developing a variety of in-house training materials in Spanish and is working on another version in Vietnamese. Similar issues will have to be addressed by other companies as a matter of necessity. None of the companies in this study engaged in or encouraged English language courses for their employees.

Apart from broader issues raised by globalization and a changing work economy, many companies also talked about the need for basic professional values including work ethic and accountability. This included characteristics such as punctuality, integrity, having a sense of pride in work, and having a sense of responsibility and commitment. A Crisps Inc. representative identified the importance of work ethics:

“We would like to see workers who are a little more responsible coming into the workforce, people who hold themselves a little more accountable. And the work ethic is not the same today. People have a higher immediacy for their needs.”

These values can directly impact the company. For example, a Meat Products Inc. representative mentioned that making a mistake and not admitting to it can cost the company many thousands of dollars. Thus, it is imperative to convey to employees the necessity of honesty and ethics. These qualities are even more important because most companies identified their employees as the “face of the company.” For example, a Snackers representative mentioned:

“We tell our people all the time that we are always on display and we are. Image is so important. But it goes beyond that. We have a tour gallery out here open to the public all day long. We are always on display. How we handle ourselves, the image that we portray, how we interact with each other leaves an impression on the visitors. We’re very visible.”

The dynamic workplace requires employees to enter with the ability to cope with changing environments, specific to technology, culture, and work ethics. Companies are demanding computer savvy, competent, aware, and responsible employees. Thus, curriculum development in CTE should center on these issues.

Conclusions

The primary themes that emerged through the needs assessment are specific to the food-processing industry, yet they reflect general knowledge and skills as outlined by Donlevy (2002) with respect to all CTE programs. Donlevy identified myriad skills, including developing habits of safety; understanding and managing available resources; effectively accessing technology; researching and solving problems; thinking critically and creatively; communicating effectively to superiors and colleagues; working effectively as a team member, and properly resolving conflicts. Our needs assessment refined these broad areas into 4 specific themes: workplace and food safety training, knowledge of food and production systems, mathematical knowledge and skills, and professional conduct. We also identified component skills within each of these areas and extended our discussion to encompass curriculum design. It is important to note that within the context of industry needs identified from the data, concepts related to higher level understanding and cultural diversity will require more creative curriculum interjections and may or may not be suited for the CTE level.

Further research is needed to parse out the particular aspects of curriculum content. That is, should modules be industry specific or broad in nature? Can modules be targeted to focus on meat-based industries, grain-based industries, and vegetable-based industries? As a continuing part of our project, we are conducting
an assessment of workers’ perceptions of their educational and training needs, with respect to their employment, mobility, and growth in the workplace. Authors anticipate that the knowledge of industry needs and worker needs, with respect to the desired incoming workforce competencies and knowledge, will facilitate the development of integrated curriculum modules that will enhance students’ learning and make them sought-after employees within a very competitive job market.

Moreover, collaborators in this study anticipate that the development of integrated curriculum modules, based on industry needs and worker needs, will lead to a restructuring of the current general food and agricultural sciences program at this particular CTE high school. That is, instead of teaching discrete content areas, such as animal science or culinary arts, we anticipate that the integration of competencies and knowledge will occur to focus on a more definitive understanding of the food system and how industry is organized around and through that system. As an example, curriculum modules will illuminate the path that agricultural materials travel from suppliers, to producers, to commodity handlers, to food processors, to distributors, to retailers and restaurants, and finally to consumers. In addition, unit topics may include food safety (sanitation, personal hygiene, proper handling of foods), mathematical skills, measurements, computer skills, and the basics of food science (chemical reactions, preparation, and equipment management). This focus on the food system ensures that curriculum modules maintain a strong connection and focus with real world food concerns.

Furthermore, through these curriculum modules students will learn to apply and integrate basic concepts of food production, processing, safety and quality, and real-world problems. This type of an approach to CTE can be viewed as enhancing and broadening the scope of current competencies and knowledge achieved by the student. A food systems approach increases opportunities for a broader scope of employment and subsequent democratic participation. Beyer (1998) theorizes that educators should have an understanding of the complexity of student needs, foster connections that allow for a richness of knowledge and understanding, and allow for students to become collaborative, skilled, and engaged participants within our democratic society. In addition to providing this specific CTC with information for graduates of their general food science and agricultural programs, dissemination of this information through publications and conferences will benefit other CTCs in the state, region, and nation. In turn, the integrated curriculum will serve as a model for alternative possibilities for delivering a food science curriculum to non-degree CTC graduates. The content modules to be developed as a result of this study can also be used as an educational and professional development tool by industry.

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References