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Food engineering: Attitudes and future outlook

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ABSTRACT

A global web survey was conducted collecting academia and industry perceived attitudes, identifying curriculum gaps, challenges and opportunities of food engineering (FE). Participation criterion was: “A person who has one or more formal degrees in FE, and/or an equivalent degree in another field and whose job description includes/included FE activities”. Respondents with formal FE education was lower than 25%. More than two-thirds of the respondents holding a formal BSc or MSc in FE selected other domains for their higher degrees, and 56.7% indicated that FE should become a part of another study program. Traditional FE topics were preferred over health, nutrition and wellbeing, innovation related to firm's activities, marketing molecular biology. FE profession should undergo a self-examination required to ensure its future growth and impact in addressing forthcoming challenges in the food sector, and concurrently make paradigm shifts in its vision in the pursuit of excellence and innovation.

1. Introduction

Surveys are widely utilized to assess and identify gaps in various domains. For instance, the American Society for Engineering Education (ASEE) interviewed in what is known as Phase I over 100 volunteers. The objective was to catalyze a conversation within the U.S. engineering community on creating and sustaining a vibrant engineering academic culture for scholarly and systematic educational innovation, ensure that the U.S. engineering profession has the right people with the right talent for a global society (ASEE, 2009). In Phase II a survey of faculty committees, chairs, and deans was conducted. Narrative and quantitative responses from 110 departments representing 72 colleges provided insights into current views and practice in teaching and learning, faculty preparation and engagement, and infrastructure and support for engineering education innovation (ASEE, 2012).

Phase II highlighted that as engineering careers have become increasingly collaborative, multidisciplinary, entrepreneurial, and global, and as the pace of change of technology has accelerated, the expectations for engineering education have expanded and include interdisciplinary breadth, communication, teamwork, global economic, environmental, and societal contexts, critical thinking, ingenuity, creativity, leadership and flexibility (ASEE, 2012). A more recent study utilized the ASEE survey data to identify promising pathways for transforming engineering undergraduate education. It concluded that the greatest promise for transformative change in engineering education lies in developing a shared vision for educational innovation (Besterfield-Sacre et al., 2014).

The food engineering (FE) profession is at a crossroads. Continually diminishing support from the government and other agencies, together with a lack of critical mass among university faculty particularly in the United States has taken a heavy toll on research activity, attractiveness to young students, and new academic positions. Noteworthy proliferation and flourishing of many biology disciplines has highlighted an immediate acute need for the FE profession to reassess its vision, strategy and mission to reinvigorate the domain and to sustain its future (Saguy et al., 2013).

The cliché that ‘you can't compete today with yesterday's technology’ is well known; food engineers should adopt new paradigms to avoid even the remotest unfortunate possibility of becoming marginalized and/or non-sustainable. New and innovative approaches are needed, and limiting the rethinking of their roles is not an option. More importantly, planning for the future, and what knowledge should be passed on to students are some of the key driving forces (Saguy, 2016). Consequently, *engineers of the*

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future will face bigger and more demanding challenges. Whereas *engineers of the past* mainly focused on the technical and economic feasibilities of systems design (Alwi et al., 2014), *engineers of the future* will have the additional responsibility of addressing entirely new topics and dimensions (e.g., innovation, partnerships, creativity, entrepreneurship, sustainability, economic environment, social responsibility, population growth and aging). Furthermore, food engineers will be faced with unique challenges and should play a proactive role in the innovation ecosystem. A multidisciplinary knowledge base, health and wellness, and food security are some of the key and paramount ingredients that should be included (Saguy, 2016). For instance, one such multidisciplinary illustration is Google's study on collecting information that includes: participants' entire genomes and their parents' genetic histories, as well as information on how they metabolize food, nutrients and drugs, how fast their hearts beat under stress and how chemical reactions change their genes' behaviors (Barr, 2014).

The above presents some of the rapidly evolving challenges faced by food engineers, for which they need to play a proactive role. It also calls for rethinking and transforming the domain to a vigorous, holistic and dynamic profession, which should strive to go beyond today's vision. Consequently, it highlights the need for new curricula to train both students and professors. This is a very exciting time for food engineers, who can—and should—expand their horizons by offering insights and playing a proactive and significant role in this endeavor (Saguy, 2016).

A survey carried out by the Institute of Food Technologists (IFT) Employment & Salary Survey Report conducted in 2013, 51% of the respondents said that intellectual stimulation was key to their job satisfaction, with job security (23%) coming in a distant second. The participants with specific food science job functions included only 2% FEs with the highest degrees earned (IFT, 2014).

FE surveys focusing on curricula and state of the profession are scarce. On the other hand, few examples could be drawn from chemical engineering (ChE). For instance, one survey included closed and open-ended questions to assess the perspectives of ChE students who were taught fluid mechanics and heat transfer concepts using both traditional classroom lecture and the new student-centered on paradigm for Cooperative Hands-on Active Problem-based Learning (CHAPL). The study indicated that CHAPL could differentially influence measures of significant learning and may be beneficial to enriching the learning experience (Hunsu et al., 2015). Actual conditions of the curriculum and career path of ChE field in specialized high school, and seeking for a curriculum improvement plan for activation by means of identity establishment of ChE field were also studied (Yi et al., 2015). The European ChE (EFCE) Working Party Education (WPE) seeking to identify effective educational solutions to meet the challenges caused by the rapid rate of change in technology and society world-wide utilized a 1994 WPE survey of curricula in EFCE universities to identify a first degree level core curriculum. The problem of how to adapt the discipline to meet technological and societal changes without losing its identity was addressed. Basic sciences, ChE science, integrated systems design and holistic thinking were emphasized as essential elements of the discipline. It was suggested that the impact of changes arising from industry, new technology and society has driven the ChE discipline to a point where it is now ripe for re-invention. It also highlighted the impact of rapid industrial, technological and societal changes on ChE education. Curriculum development, personal development and life-long learning as three important factors for educating chemical engineers for a successful future were identified (Gillette, 2001). Another survey was carried out in China that has the largest global population of ChE students. It included 2158 students/engineers from more than 20 countries regarding their educational and professional career satisfaction with their major in ChE. The Chinese students/engineers (33%) indicated that they were not satisfied with their ChE selection as their subject of study or discipline for professional career. The survey has attracted widespread attention among Chinese university professors of ChE focusing on the questions how to encourage and attract excellent high-school students to the exciting world of ChE science and technology, and the pivotal role that the discipline plays, and will play even more in the future (Jin and Cheng, 2011).

Evolution of the education needs and the necessary paradigm shifts needed for ChE education and recent and future trends that have been impacted by shifts in academic research and industry needs were reported. For instance, next paradigm is likely to be one involving the integration of multiscale and systems analysis. In addition, the importance of promoting innovation in the curriculum to support the creation of new products and processes and encouraging entrepreneurship among students in ChE (Varma and Grossmann, 2014). The similarity with FE status may indicate that the debate on future education needs, and the role of innovation and entrepreneurship are quite parallel.

Internet resources to reproduce aspects of more sophisticated customer-research techniques via modern web-based user research in new product development (NPD) are frequently utilized due to low cost and the ability to reach a wide audience in a cost-effective manner (Shekar and McIntyre, 2012). For instance, a web-based survey was developed to let consumers assess the use of meat substitutes in different dishes. The survey consisted of 38 key questions with subdivisions and was completed by 251 respondents (Elzerman et al., 2015).

The aforementioned reports clearly highlighted some of the paradigm shifts and educational innovation and other topics such as collaborative, multidisciplinary, entrepreneurial and creativity have attracted a lot of attention, and also warrant a similar attempt at FE. Hence, the overall aims of this study were to assess the status of FE education, positions and attitudes, to identify possible gaps, and to recommend (where needed) possible additional topics to be considered for future curriculum development. To avoid the confusion caused by multiple, different, and sometimes conflicting global educational standards and definitions, the FE definition used in this study was: “A person who has one or more formal degrees in FE (BSc, MSc, PhD, DSc), and/or an equivalent degree in another field, and whose job description includes/included FE activities.”

2. Methodology

The methodology used in this manuscript consisted of a structured questionnaire that was designed based on information gathered from food science and FE specialists. This questionnaire was conducted through an online survey using Qualtrics© software (http://www.qualtrics.com/). Before the survey was written, the prime author completed the prerequisite course: Collaborative Institutional Training Initiative (CITI Program; https://www.citiprogram.org) and obtained Helsinki authorization from the Committee for the Use of Human Subjects in Research through The Robert H. Smith Faculty of Agriculture, Food and Environment of The Hebrew University of Jerusalem (file: AGHS/01.15). The questionnaire was pretested (but the data were not utilized in the final analysis) using a preselected sample ($n = 38$) of leading food engineers from academia and the food industry to ensure its consistency and to seek inputs on additional topics. The suggested recommendations were incorporated into the revised survey, and it was then distributed by e-mail to a very wide audience consisting of numerous organizations, people and geographical locations (see acknowledgments section for full details). The criterion for participation in the survey was: holding a formal FE degree (i.e., BSc, MSc, PhD, DSc) and/or an equivalent degree in another field, and holding