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Industry-Academia Connect in the Food Sector: Preparing Future-Ready Professionals

Deepali Sachin Khedekar[1], Tarannoom Khan[2]

[1]Assistant Professor, Department of Microbiology, S.I.W.S. College, University of Mumbai, India.
Email: *deepalinijapkar[at]siwscollege.edu.in*

[2]Assistant Professor, Department of Microbiology, K.J. Somaiya College of Science and Commerce, University of Mumbai, India
Email: *tarannoom[at]somaiya.edu*

Abstract: ***Sustaining the rapid technological advancements along with evolving industrial demands requires innovation and skilled workforce. The collaboration between academia and industries is pivotal for fostering such innovation and skill development. The food industry is one of the most diverse sectors, with opportunities in the areas of food safety, quality assurance, biotechnology, processing, and product innovation. Hence, its growth demands involvement of graduates who are technically proficient and can efficiently contribute practical solutions to real-world scenarios. This review synthesizes evidence of transformative potential of academia–industry collaboration in the food sector, based on existing literature and global practices. The review further examines the potential of collaborative measures including curriculum development, skill enhancement, internships, microbiological applications and regulatory training in enhancing transformative learning approaches. Furthermore, the review explores various models of academia–industry collaboration, and highlights key considerations for bridging the gap between academic training practises and industrial expectations. Overall, it can be emphasised that ensuring food safety and product innovation requires integration of microbiological principles and standard safety guidelines in technological processes.***

Keywords: Industry, Academia, product innovation, internship, food sector, transformative learning.

1. Introduction

The central objective of higher levels of education is employability. Graduates with relevant skills and technical expertise are professionally competent to address real life scenarios and fulfil the current market demands. Educational institutions increasingly face the challenge of designing a curriculum that effectively develops skills suited for management of work pressure in industrial sectors and maintaining a healthy work-life balance, especially in areas where rapid technological advancements are observed (Abelha et al., 2020). Many published literature consistently addresses the gap between industry requirements and graduate readiness, particularly pertaining to the soft skills, adaptability and flexibility to real-world professional approach to challenges arising in every-day tasks (Mohammed and Ozdamli, 2024; Iqbal et al., 2022). One important and relatable example of such real-world scenario can be explained through the unexpected challenges faced during the COVID-19 pandemic. This phase emphasized the need for digital preparedness, resilience and opting to non-standard protocols to maintain quality standards in industrial products, while practicing strict regulatory guidelines of social distancing, lockdown, transportation and handling of items (Kumar et al., 2022). To strengthen the industrial outcomes and ensure continuous progress, it is therefore important to bridge the gap between academia and industry (European commission, 2021).

The prerequisite for sharing good practices on how to bring industry into the classroom and how to get students into industry is a recently raised question (Kavanagh and Drennan, 2008). While addressing this, it is important to understand that merely designing an exam-based curriculum is insufficient for bridging the existing gap between academia and industries. Instead, the incentive- based methods and industry engagement programmes may help inculcate a professional problem- solving mind-set among students, more effectively (Ahmed et al., 2022). Precisely, a study by Smith et al. (2014) reported that Industry-academia collaboration positively improves students' attitudes towards conceptual learning, skill development and mitigation of real life challenges.

Currently, the academic curriculum design provides intense contextual knowledge without sufficient practical exercises, which is necessary to develop suitable expertise relevant for exposure to work-life environment in the industries (Selamat et al., 2025). Practical experience is indispensable for students to succeed in the professional world. Through Industry-Connect programmes, students gain hands-on experience (Gutiérrez-Pulido and Orozco-Rodríguez, 2025). Opportunities such as internships, industry projects and other practical training programs prepare students to develop confidence and succeed in the professional world (Schnoes et al., 2018). The experiences gained during such tasks help students to apply the concepts and theories they have learned in the classroom in to the real-world situations (Gutiérrez-Pulido and Orozco-Rodríguez, 2025; Schnoes et al., 2018). Overall, these opportunities help in developing skills necessary for adapting to industrial environment and reducing the industry-academia gap. This is particularly relevant in the Indian context where gaps exist between professional expectations, industrial goals and relevant competencies (Selamat et al., 2025; Peng et al., 2024).

To align higher education with evolving needs of the food sector, it is hence necessary to strengthen industry–academia collaboration. This review examines existing literature and global practices related to industry–academia connect in the food sector, and highlights workforce requirements, collaborative strategies, and emerging trends. Through these

insights, the study highlights most suitable ways for preparing future-ready professionals who can effectively contribute to competitiveness in the food industry.

2. Methodology

2.1 Study design

This study adopts a narrative review approach (Ahmad, 2025) to collate existing literature on industry–academia collaboration with specific reference to the food sector, and synthesizes literary evidence on workforce development and employability.

2.2 Data sources

Relevant literature was identified through electronic databases, including Google Scholar, Scopus-indexed journals, and reports from international organizations such as the World Economic Forum, McKinsey & Company, and the European Commission to review global insights on higher education, skill development, and industry–academia engagement.

2.3 Search strategy

Combination of keywords was used for searching databases. The primary search terms included 'industry–academia collaboration', 'food science education', 'employability skills', 'work-integrated learning', 'transformative learning', and 'food industry workforce'.

2.4 Inclusion and exclusion criteria

Peer-reviewed research articles published, in English language, between 2010 and 2024 were included in the study. In addition, relevant policy reports and white papers addressing higher education and workforce development were reviewed. Studies focusing on food, nutrition, and allied sectors were also refereed thoroughly for relevant information.

All opinions or draft pieces without scholarly grounding were excluded from the study.

3. Workforce Requirements in the Food Sector

Globally, the food processing industries are very vast and comprises of various sectors involved in manufacturing, processing, preservation, packaging, distribution and safety standards of food products. Hence, there are attractive career opportunities in the field of production, research and development, quality assurance, regulatory affairs, supply chain management, and product innovation (Michel et al., 2024). In India, this sector is a significant contributor to the national economy, and accounts for approximately 6% of Gross Domestic Product **(**GDP), 13% of Indian exports, and 6% of overall industrial investment in the country (IBEF Report, 2025). The food industries also play a significant role in sustainable product development by addressing food security, nutrition, waste reduction, and environmentally responsible processing practices (Rabbi and Amin, 2024). All these factors stress on the need for skilled professionals in food and related fields.

The food industry precisely needs professionals with a strong basic knowledge in food science and technology, nutrition, processing, preservation, packaging, quality and safety, distribution and environmental issues, for efficient working. In this context, preparing graduates through a combination of soft and hard skills during their academic years can reduce the time invested in training of freshers, which will ultimately improve industrial outcomes (Sugiarti et al., 2021). The soft skills are general qualities that help an individual to excel in professional environments, and include the art of communication, teamwork, problem-solving ability, adaptability, loyalty and professional ethics (Mohammed and Ozdamli, 2024). Along with these soft skills, industry specific hard skills that encompass both theoretical understanding and practical competence are necessary from a technical perspective (Muzulon et al., 2025). To a large extent, these skills can be gained through the practical and theoretical knowledge of the following:

3.1 Technical and scientific competencies

Graduates entering the food sector are expected to possess strong foundational knowledge of food science and technology, food microbiology, food chemistry, nutrition, and public health (Sugiarti et al., 2021). Competence in traditional and modern food processing technologies is also essential to ensure product safety, quality, and nutritional adequacy (Kirby and Teixeira, 2025). Additionally, an in depth understanding of the mechanisms of food spoilage and preservation is critical for minimizing losses and ensuring consumer safety (Akyazi et al., 2020).

3.2 Food safety, quality, and regulatory skills

Food safety and quality assurance represent core responsibilities within the food sector. Hence, professionals must be well versed with national and international regulatory frameworks such as Food and Drug Administration (FDA), United States Department of Agriculture (USDA), Food Safety and Standards Authority of India (FSSAI) regulations, Codex Alimentarius, Good Manufacturing Practices (GMP), and Hazard Analysis and Critical Control Points (HACCP). Regulatory literacy is particularly important as non-compliance can have direct consequences for public health and market access (Kirby and Teixeira, 2025; Akyazi et al., 2020).

3.3 Digital, technological, and innovation-oriented skills

Rapid technological advancements are reshaping the food sector. Automation in processing, digital quality management systems, traceability tools, and the application of Artificial Intelligence (AI) in food safety monitoring are increasingly adopted (Akyazi et al., 2020). Also, areas such as food biotechnology, genetically modified foods, nanotechnology in packaging, and functional and nutraceutical foods are emerging worldwide (Michel et al., 2024). All these advances point towards the need for graduates and professionals who are technologically adaptable and innovation-oriented.

3.4 Sustainability and Ethical Competencies

Sustainability considerations have become integral to food sector operations. Professionals are expected to understand environmentally responsible processing, waste management, resource efficiency, and ethical dimensions of food production and implement them at each step of industrial process (Rabbi and Amin, 2024). Aligning food systems with Sustainable Development Goals (SDGs) requires balancing economic viability with environmental and social responsibility, which can be taught best with industry–academia collaborations (Michel et al., 2024).

3.5 Soft Skills and Professional Competencies

In addition to technical expertise, the food sector places strong emphasis on soft skills such as communication, teamwork, critical thinking, and problem-solving. Food sector professionals frequently operate in multidisciplinary teams and must communicate effectively with regulatory authorities, production teams, and consumers (Kirby and Teixeira, 2025). Decision-making under regulatory and quality constraints further highlights the importance of professional judgment and adaptability.

Overall, a collaborative approach between academia and industry is most practical approach to ensure that graduates are able to translate academic knowledge into real-world applications. Aligning academic curricula with industry expectations through experiential learning, mentorship, and transformative learning are meaningful approaches to prepare graduates for sustainable careers in the food sector.

4. Strategies for Strengthening Industry–Academia Connect

To ensure that educational outcomes align with evolving industrial needs, it is necessary to strengthen the link between industry and academia. The most effective strategies based on literature review must focus on curriculum, experiential learning, industry engagement, and exposure to real-world industrial environments.

4.1 Curriculum and industrial visits

The educational institutes must acknowledge the importance of teaching the contemporary landscape of the food industry, including their regulations, current issues, and consumer trends. This can be done by designing the syllabus with strong foundational knowledge in basic food science and technology, and introducing regulatory standards laid by FDA, USDA, GMPs, HACCP and FSSAI. These regulatory bodies encompass food processing, safety, quality and labelling standards (Kirby and Teixeira, 2025; Akyazi et al., 2020).

In addition, integrating certificate courses in to the curriculum can further enhance expertise and skills by providing domain-specific learning opportunities (Fu, 2024). In best case scenario, the industry experts should be a part of curriculum design and career development programs, since their insights can help align the academia with industry expectations. Besides, arranging conferences, workshops and seminars, within the academic framework, with expert talks on current trends in the industrial sector can encourage students to more confidently choose a sector, based on real expectations and exposure (Selamat et al., 2025).

Visits to food and health industries is another practical approach to learning for students, as it bridges the gap between theoretical learning and practical exposure. These visits provide students with the opportunity to identify the inputs and outputs of different business operations and processes performed at the workplace. These exposures also help students in identifying their areas of interest, and familiarize them with professional working conditions and actual processing plant (Staples et al., 2025).

4.2 Internships

Internships are widely recognized as a valuable component of higher education, particularly in technical fields, engineering and applied sciences. Internships provide students with opportunities to gain practical experience, enhance their job skills, and facilitate their transition into the workforce (Gutiérrez-Pulido and Orozco-Rodríguez, 2025). Employers value internships as a means to assess potential employees' skills, attitudes, and work ethics. Internship programs also benefit higher education institutions by attracting potential students, enhancing their status and promoting stronger bonds with industry partners (Panakaje et al., 2024).

Internships can vary in their structure, duration, and level of compensation. They can be paid or unpaid, provide academic credit or just industrial exposure, and focus on specific learning outcomes and experiences (Gutiérrez-Pulido and Orozco-Rodríguez, 2025). According to the review by Velez and Giner (2015), students' mainly expect internships to broaden their work experience, provide technological training and enhance job placement. Contrarily, the employers emphasize that internships should develop job skills, relation and interpersonal skills. Furthermore, education and training should impart individuals with a standard of marketable skills that increase their productivity and consequently their financial stability (Suleman, 2016). In the strategically important food sector, all these considerations are greatly important for an improved performance and increased competitiveness. Regardless of their specific format, internships play a crucial role in bridging the gap between academia and industry, providing students with real-world experience and valuable insights into the workplace (Gutiérrez-Pulido and Orozco-Rodríguez, 2025).

Several leading Indian food companies offer structured internship opportunities for effective industry engagement. For instance, Amul, Britannia and Nestle India offers internships and also hires interns through campus placements, making it an excellent opportunity for students. Amul is an acronym for Anand Milk Union Limited. It is one of India's largest Multinational cooperative societies with a turnover of 72,000 crores (Jonwal, 2025). Britannia is a household name in India, and it is one of the country's leading producers of bakery, dairy, and other snacking products. The operations of this company expand over 80

countries in the world. Recently, Britannia offered a rewarding internship opportunity to one lucky "Croissant pronunciation expert" offering Rs. 3 lakh for a one-day internship where the winner's only job was to walk around the Britannia office and correct people who pronounce "croissant" incorrectly (Britannia Industries Limited, 2024). Similarly, Nestle India offers Internships across different streams such as sales, marketing, human resource, supply chain & food technology, through a well-defined and robust selection procedure in conjunction with the campuses (Nestlé India, n.d.).

Overall, internships constitute a cornerstone of industry–academia collaboration in the food sector. When strategically designed and effectively implemented, they not only enhance student employability but also support industry talent and contribute to the long-term sustainability and competitiveness of the sector.

4.3 Career counselling cell and placement support

Including career counselling and placement support for students through industry-academia connect programs is another suitable approach to encourage students in pursuing a career in food industries (Menezes and Salgado, 2023). Career counselling and guidance helps students identify their strengths, interests, and career goals. It also introduces them to the current requirement of an industry (Alnajjar and Abou Hashish, 2024). Thus, structured career guidance initiatives contribute to better job preparedness by enhancing students' awareness of current industry requirements, emerging roles, and skill gaps.

The campus placement programs significantly reduce job search related stress for dedicated students, since it facilitates smooth transition from academic life to professional careers (Panakaje et al., 2024). As an encouraging step supporting such programs, academic institutes should not only collaborate with companies and organizations for placement support but also help students' prepare for interviews and other aspects of the job search process. Additionally, conducting aptitude tests such as Ikigai and Pyschometric tests on regular basis can help students' recognize their potential in respective careers (Mahajan, 2025). In the Indian context, where employability remains a critical concern, robust placement along with career counselling can significantly reduce the gap between academic training and industry expectations (Ahmed et al., 2022).

4.4 Mentoring and network building through alumnus

Forming an alumni association in colleges, institutes and universities is an excellent means to promoting and encouraging close relations between industry and academia. An alumni mentorship program can be built up through such associations. Alumni mentorship programs precisely facilitate the transfer of practical knowledge, industry insights, and professional guidance from experienced professionals to students (STEMM, 2019). These opportunities create a sense of learning, refines professional skills, and develops better understanding of workplace dynamics. In alumni associations, a mentor often plays a central role in expanding the professional network of mentee's by sharing opportunities, and recommending events and stretch assignments that expose them to important information and connections (Hillage et al., 2022). In addition, mentors are a source of wisdom, and can reshape the professional identity of the mentee (STEMM, 2019). Ideally, alumni mentors are individuals who can provide career advice, and constructive feedback to help students improve and develop career aspirations. Hence, they should be selected based on their experience and expertise in their respective fields (Hillage et al., 2022). According to Mentorloop, 97% of mentees report their experience to be valuable. Thus, collaborative projects facilitated through alumni networks can help students establish valuable connections that may lead to internships and job opportunities (Mentorloop, 2025).

5. A Transformative Learning Experience

Jack Mezirow describes transformative learning as an experience that integrates practical skills, soft skills, and industry connections to prepare students for the ever evolving demands of the job market. Jack Mezirow is known as the founder of transformative learning, who began his theory while studying the experiences of adult women who went back to school. Based on his observations and analysis, he theorized that students had important teaching and learning opportunities connected to their past experiences. He emphasized that critical reflection and critical review could transform an individual's understanding (Fleming, 2018). Mezirow's theory has now been expanded and it largely supports the idea that learning changes the perspective of individuals towards the challenges, and that helps in grasping new concepts and ideas more efficiently (WGU Blog, 2022).

A previous report by the World Economic Forum (WEF) suggested that 54% of all employees shall require significant reskilling and up skilling by 2022, due to technological advancements (WEF Report, 2019). More recently, the WEF's Future of Jobs Report 2023 projected that almost a quarter of jobs (23%) may change in the next five years, with 69 million new jobs created and 83 million eliminated (WEF Report, 2023). To a large extent, AI has been perceived as a substantial threat for many individuals. While some believe that the rise of AI will lead to a jobless future, others, willing to reskill and upskill, are convinced with the possibilities of new opportunities in diversely evolving domains of industries (Nigar et al., 2025). Regardless of the scope or threat of AI, the WEF reports highlights the importance of developing skills for the "jobs of tomorrow," particularly those needed for the digital, green, and energy transitions. The most recent WEF annual meet 2024 also emphasized the "*Race to Reskill*" as an ongoing norm of the industrial sector where innovative approaches to reskilling, upskilling, and job transitions are increasingly adopted (WEF Report, 2024).

Jeff Maggioncalda, Chief Executive Officer of Coursera, Inc., also supports generative AI by stating its potential in bridging the gap between those with more and less experience. His explicit statement that "talent is equally distributed, but opportunity is not, and technology has

exacerbated this inequality", suggests that AI can help reduce disparities in experience and opportunity (Coursera, 2025). While traditional AI focused on system builders, generative AI can be used by everyone, potentially closing performance and experience gaps. Research suggests that knowledge workers with less experience see a greater improvement in their capabilities when using generative AI tools compared to those with more experience (Lee et al., 2025).

However, to achieve a balance in talent, experience and opportunities, there is a need for higher education systems to invest in vocational and technical training facilities to create opportunities (Mustajab and Irawan, 2023). Collaborative partnerships are equally vital to achieve this balance, since it impacts the skill sets and has transformative potential in venturing career possibilities that young generation may not have previously considered (Peng et al., 2024). Additionally, collaborations between the public and private sectors may particularly aid reskilling initiatives. For instance, refurbishing the curriculum, and establishing a national qualification system through systematic approval from Ministry of Education and private sectors can form a means of directional guidance for students (Menezes and Salgado, 2023). However, private sector investments may be required to support these programs.

According to a survey by McKinsey & Company, 87% of education leaders believe that higher education institutions are not adequately preparing students for the workforce. The survey further reported that employers value skills such as problem-solving, critical thinking, and communication more than specific technical skills (Mourshed et al., 2012). Additionally, the employers value communication, teamwork, and problem-solving skills more than a candidate's major when making hiring decisions (Iqbal et al., 2022). These statistics strongly advocate the need for transformative learning experience through Industry Connect programs to align academic learning with workplace expectations.

6. Conclusion

Education is no longer limited to the classroom. While the open access to theoretical knowledge through internet enhances academic learning, collaborations between industry and academia is essential for exposure to the real-world situations. As the world is moving towards digitization and new technologies, the traditional boundary between academia and industry is gradually restructured. The symbiotic relationship between educational institutions and businesses has given rise to a paradigm shift in the form of industry-academia collaboration. It is nothing but an interaction between the higher education system and industry to exchange knowledge and expertise. It provides organisations with a mix of academic rigour and practical expertise. Through reframed curriculum, internships, strong placement cell, mentoring and transformative learning, the industry academia gap can be systematically narrowed.

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