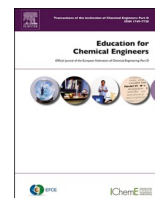




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Bridging the academia-industry gap in the food sector through collaborative courses and internships

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ABSTRACT

Experience is an important requirement to apply for a qualified job. While employers need to find workers with the required skills, education institutions must design curricula which provide the skills demanded by the job market. Besides, along their careers, workers need to make good choices on continuing education courses. Current Bachelor and Master degrees follow programs which attempt to offer a practical perspective, but still from the academia point of view. To bridge the gap between academia and industry, University Extension Diploma in Food Technology (DEUTA) deepens into the Food sector seeking professional capacitation of participants. This is achieved by both first-hand know-how of food sector professionals and academics, along with an internship period in a food company. This paper reports the experience for more than fifteen years of this Diploma. Curriculum, students background, food sectors where internships are taken, student's opinion on the course management as well as on issues related to employability, development of professional skills and life-long learning are discussed. The analysis demonstrates how collaborative courses strengthen academia-industry bonds, and employability is boosted thanks to internships and the network created. This experience may be extrapolated to many sectors other than food, such as the chemical, environmental or biotechnological, and may help lecturers and institutions organize similar courses or diplomas to prepare competent and efficient technical workers, as well as help students and professionals orient their training and continuing education choices.

1. Introduction

Employability is one of the pillars of the European Employment Strategy. It is defined as “a combination of factors (such as job-specific skills and soft skills) which enable individuals to progress towards or enter into employment, stay in employment and progress during their careers”, and aims to prevent long-term unemployment and to facilitate access to the labour market (Eurofound, 2021). While employers need to find workers with the required skills, institutions must face the challenge of designing curricula which provide the skills demanded by the job market. Furthermore, workers (and future workers) need to make good choices on employment, as well as on training and lifelong-learning courses which provide them with the appropriate competences.

Workers need to be equipped with a variety of skills ranging from basic to vocational or technical ones, together with transversal skills (entrepreneurial, digital, learning to learn...), in order to succeed in

finding a job and promoting or evolving in their careers. Academic institutions have been asked to define degrees which prepare students for the labour market; nevertheless, succeeding in the job market requires competences for which collaboration between industry and academia is essential. This is of particular application to technical and engineering profiles, since their education and training should reflect social, economic and technical developments (Tayeh and Issa, 2021). In fact, the way we work, learn, take part in society, and lead our everyday lives is changing with technological developments, global and demographic challenges. Despite this evidence, the available literature in the field still reveals a gap between industry requirements and graduate's preparedness, mostly regarding soft and nontechnical skills such as communication and collaboration, or adaptation to real world-changes, among others (Leite et al. 2016; Mahasneh & Thabet, 2015). The recent outbreak of COVID-19 pandemic has also negatively impacted job opportunities for many. Furthermore, it has boosted telework and distance

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learning, which has revealed current limitations of digital preparedness (European Commission, 2020).

The food and beverage processing industry is among the most important and largest industries around the world. Recently, Prado (2021) has reported the numbers for this industry in America, Europe and Asia, and has revealed the relevance of this industry for Chemical Engineers to develop their careers. In this paper, it is cited a survey conducted by Shallcross (2006) who concluded that the number of undergraduate chemical engineers who marked food and beverage industry as their first preference for employment on graduation was higher than petrochemical, and pulp and paper industries. Another interesting result of this survey was that the food and beverage industry was the second choice between female chemical engineer students, which is a remarkable information considering the interest of higher education institutions on increasing the enrolment of female students and other minority groups in engineering studies (Prado, 2021). Environmental awareness has also been related to this trend. In fact, the food industry is called to have a crucial role in sustainable development and the achievement of the Sustainable Development Goals (FAO, 2015) adopted by the United Nations. The transition towards sustainable food systems and a sustainable food production requires a whole re-thinking in which processing and industry are involved. In this context, food engineering and related technological areas such as biotechnological or environmental are called to play an essential role. All the previous are among the industrial sectors which employ chemical engineers and are among the preferred career choices for undergraduate chemical engineers (Shallcross, 2006).

The need for sharing good practices on how to bring industry into the classroom and how to get students into industry is a question recently raised in this journal (Kavanagh, 2021). Industry-academia collaboration has been reported to improve students' attitudes and to be positive in several aspects (Smith et al., 2018). According to the review carried out by Sanahuja Vélez and Ribes Giner (2015), students' expectations about internships include to broaden work experience, provide technological training and enhance job placement; whereas employers believe that internships should develop interns' job skills, relation and interpersonal skills. Employers give especial value to positive and responsible attitudes, professionalism, and communication skills, and believe students should be willing and enthusiastic participants. Internship programs are also beneficial to higher education institutions since this attracts potential students, enhance their reputation and visibility, and strengthen bonds of collaboration between the academia and industry. Moreover, education and training impart individuals with a stock of marketable skills that increase their productivity and consequently their earnings (Suleman, 2018). In the strategic food sector, all these considerations are greatly important for an improved performance and increased competitiveness.

University-industry collaborations can occur in different ways and, when properly designed and managed, they are beneficial to both academia and industry partners. These collaborations may take place at different scales and have different purposes: e.g. they can be research-motivated or focused on providing experience to enhance education (Peters & Lucietto, 2016). Collaboration may take place in the academic context, e.g., by company members participating in courses (Baroutian et al., 2016); or either in the industry context, mostly by means of internships, but also by short visits to company departments. As for internships, there is also a variety of options since they can vary in their structure, they can be paid or unpaid, provide academic credit or not, tie to specific learning outcomes or tie to experience outcomes (Matusovich et al., 2019). There is a consensus on the importance of internships in companies in achieving a complete and comprehensive education (Feijoo et al., 2019), which is of especial relevance for technological and engineering degrees.

Both official and non-official courses and degrees may benefit from academia-industry collaboration. In fact, with the Bologna process, University official degrees have been designed considering employers

and experts' opinion; in addition, these degrees usually provide students the opportunity to participate in curricular or extracurricular internships, mostly in the last years. However, other type of collaborations such as industry members directly participating in courses and activities are quite limited in official courses. In contrast, non-official courses, masters or diplomas, do have the possibility of providing professional experience in the classroom, facilitating contact with real life and learning from real situations.

Among the non-official courses mentioned in the previous paragraph, UPV (Universitat Politècnica de València) offers its own degrees within the lifelong learning offer, which correspond to the highest level of these kind of degrees, oriented to academic or professional specialization. These are equivalent to level of qualification 7, according to the European Qualifications Frame (EQF), for postgraduate (Master, Specialization Diploma and University Expert) or equivalent to level of qualification 6 of the EQF, in the case of University Extension Diploma. University Extension Diplomas are 30–49 ECTS credits courses oriented to deepen, mostly from a practical point of view, into specific knowledge areas seeking professional capacitation of participants. Enrolling these kind of Diploma degrees requires having passed the university access exam.

The UPV is a Spanish public educational institution founded in 1968 that has a very high level of student satisfaction due to the high employability rates of the degrees it offers, the bonds with other educational and research institutions worldwide, and its wide range of continuing education opportunities. It is one of the top three Spanish universities regarding R&D cooperation agreements with private companies and is leader in patents and technology licensing. UPV is a reference institution regarding food related studies, ranking 41st on the Shanghai list (Shanghai Ranking, 2021) as for Food Science and Technology, classified within Engineering disciplines. UPV also reaches outstanding positions in this ranking in chemical engineering, agricultural engineering and biotechnology. At UPV, official Food Engineering related studies include bachelor's degrees in Food Science and Technology and Agri-Food Engineering (Food Industries intensification), both taught in the Escuela Técnica Superior de Ingeniería Agronómica y del Medio Natural (ETSIAMN); official Masters degrees in Food Science and Engineering (MUCIA) and in Food Quality and Safety Management (MUSGA) are organized by the Institute of Food Engineering for Development (IIAD), within the Food Science and Engineering PhD Program. These official degrees have been designed considering industry requirements and new skills demanded by the labour market; thus, they have been developed to provide specific competences, which are characteristic of each degree; together with generic ones, as defined by the UPV transversal competences institutional project (Proyecto Institucional and UPV, 2015). As said, the UPV is characterized by a high degree of transferability and by having contact with companies and industry. Nevertheless, despite this professional-oriented profile, most of the courses which are part of food official degrees are taught by academics.

On the other hand, the IIAD also offers the University Extension Diploma in Food Technology (Diploma de Extensión Universitaria en Tecnología de Alimentos, DEUTA) since the academic year 2004/05, as part of its lifelong learning offer. This diploma combines both academia and industry participation (50 % of taught hours), and a final 250-hour internship in a food company, which provides a particularly job-oriented approach in which students benefit from both academia and industry knowledge and expertise. Although this diploma has mostly been taken by agri-food engineers and food technology students or graduates, it is also offered to other degrees' students and graduates, chemical engineers being among them. As raised by Prado (2021), the core of food engineering and chemical engineering courses is an essential requirement for a professional in charge of the production plant of a food industry. Besides, these professionals need to be formed and trained in food science and technology, nutrition, quality and safety or environmental issues. Thus, in addition to facilitate access to the labour

market and improve relationships with the food industry, the other main aim of DEUTA is to provide opportunities to be trained in those areas which are not part of the degree being taken, or have not been revised in depth, in order to redirect a professional profile towards the food industry.

This paper summarizes the experience acquired during more than 15 years through this industry-academia collaboration diploma. It discusses different key aspects, from curriculum to students experience and fulfilment, with the purpose of explaining this 15-years' experience and help teachers and institutions in organizing similar courses or diplomas, students in orienting their choices, and companies in suggesting courses to their employees.

2. Materials and methods

2.1. Diploma description

The syllabus of the University Extension Diploma in Food Technology (DEUTA) is summarized in Table 1 (CFP-UPV, 2021). This diploma consists of 33.5 ECTS divided in 18 modules dealing with 18 different agri-food sub-sectors. These were selected in collaboration with the Agri-Food Business Federation of the Valencian Community (FEDACOVA) for its relevance in the economy of the region (FEDACOVA, 2021). Each module (1.12 ECTS) is taught in two 5-hour seminar sessions which are scheduled on Friday afternoons from September to July. This schedule has been defined to make this Diploma compatible with work or other academic activities. The lifelong learning UPV office offers the Diploma as a whole course, but also as individual modules to be taken separately. Some modules include visits to companies or experimental trials, to provide students a more practical view. The academic year begins with an inaugural conference in which a representative of the agri-food business federation (FEDACOVA) participates together with a representative of the organizing institution (IIAD-UPV).

The contents of the modules generally included (i) the characteristics of the raw materials and products (ii) a description of the manufacturing processes involved in each food sector, (iii) the quality and safety assessment methods currently being applied, as well as (iv) market and innovation trends and development of new products. It is important to note that the module contents are taught, on average, 50 % by academics (UPV lecturers) and 50 % by food industry professionals, as required by the UPV regulation for these diplomas.

Table 1
Syllabus of University Extension Diploma in Food Technology (DEUTA) (CFP-UPV, 2021).

Subject	ECTS
Inaugural conference	0.5
Fruit and vegetable	1.12
Juice industries	1.12
Industrial bakery and pastry	1.12
Egg products	1.12
Alcoholic beverages	1.12
Dairy industries	1.12
Edible fats and oils	1.12
Meat products	1.12
Seafood	1.12
Snacks	1.12
Frozen and convenience food	1.12
Honey	1.12
Animal feed	1.12
Water and soft drinks	1.12
Food additives	1.12
Candy and chocolates	1.12
Waste management in agri-food-industries	1.12
Innovation, leadership and teamworking	1.12
Internship/Supervised technical report	10
Technical Presentation of the results	3

- i. Chemical, physical, and nutritional properties of the **raw materials and products** manufactured in each sub-sector are described. This knowledge is key to be capable of designing and understanding the transformation process. This includes knowledge on composition or functional properties, for instance, but also on properties which are relevant from the engineering point of view such as rheological or heat transfer properties of food materials. These are contents commonly taught in Food Science and Technology Degrees and, to a lesser extent or only partially, in Agricultural Engineering, Nutrition or Biotechnology degrees. However, food properties are not generally a part of Chemical Engineering degrees. Both academics and industry participants are involved in this part of the module, although it is common that academics have a higher load.
- ii. Contents related to **the manufacturing processes** include the chain of unit operations needed to transform raw materials into intermediate or final products (detailed description of the process diagram); the process variables to be considered and how these determine product quality; the equipment and machinery required; relevant auxiliary processes, if any; co-products or by-products generation; processes and product improvements; quality and safety control parameters; or waste valorisation processes. Process engineering applied to food materials are core contents of Food Engineering and Food Technology courses and, to a lesser extent, of Agricultural and Agri-Food engineering degrees. Although not that focused on food materials, process engineering is also central for Chemical Engineers. Nutrition and Food Science degrees do not include these contents in their curricula or are more marginal. Both academics and industry participants are involved in this part of the module, external participants providing a more practical point of view.
- iii. Setting up **food safety and quality management systems** are a key aspect of any food company since food companies need certification for these systems in order to comply with regulations and legislation. Nevertheless, every industry has different food risks, and here there is the value of the practical application to each sub-sector. This requires not only knowledge on the quality systems themselves, but also on food processing and food properties. Food quality and safety assessment methods are quite specific for Food Science and Technology degrees, although these contents might be partially present in related studies. These contents may be introduced either by an academic or a company representative; however, company representatives are the ones that usually are aware of the most critical points of a particular manufacturing process. Accordingly, examples of document management and verification of these quality systems are included in the sessions.
- iv. The **market and innovation trends and development of new products**. Although some general formation in economics and marketing are usually taught in official degrees, market and innovations trends are not that present. In addition, trends are in continuous evolution for which the participation of industry collaborators is believed to be essential. Therefore, although both academics and industry participants may be involved in this part of the module, companies usually have more participation in this section. These contents are usually in charge of the R&D department of the companies collaborating in the course, who usually take the chance to present valuable information on the company history and sub-sector, including economic data and trends.

Other modules, such as “waste management in agri-food industries”, “innovation, leadership and teamwork”, or “additives in the food industry” are transversal to all food sub-sectors, for which do not follow the previous structure. “Waste management in agri-food industries” includes general contents of contaminations sources and problems, and

preventive strategies; as well as engineering aspects and solutions such as minimising systems, wastewater treatments, or atmospheric contaminations treatments; measurements and information required to meet legal and normative aspects are also discussed. On the other hand, “innovation, leadership and teamwork”, is a module which basically deals with generic competences of professional interest, which are basic to succeed in the labour market. The concept of innovation and innovation strategies, as well as teamwork, leadership, personal values, or time management are addressed in this module. The module “additives in the food sector” updates knowledge on food grade additives and colorants, and related legal and normative aspects.

The diploma also includes a 250-hour period of internship in a food company (equivalent to 3 months of 4-hour workdays) which can be completed anytime between September and December of the subsequent year. At the end of the course, a closing day is scheduled which aims at sharing experiences in a seminar-like session. Before this oral presentation session, students should deliver a report on the contents of the internship (departments, activities), as well as on their opinion and experience.

Modules are usually planned to take place in a face-to-face modality, since this allows students a closer contact with classmates and professionals, which stimulates networking and relationships. However, the COVID-19 pandemic brought some changes to the diploma. From March 2020 to July 2021, modules were taught in online synchronic format through the Teams® platform. Limitations due to sanitary issues also had an impact on internship programs, so that students were given the opportunity to choose between completing an internship or preparing a supervised technical report. Face-to-face modality has been retaken from September 2021 due to the better sanitary situation.

Students’ access to internships and companies’ offers can be reached in different ways. Due to the diploma trajectory, some companies contact the coordinators who make the offer public on the e-learning platform. This e-learning platform is the official one of UPV (poliformaT, 2003), which in the context of each module is used to get access to materials, make announcements, or take tests. On the other hand, students can also directly contact companies and reach an agreement. In

both cases, student, UPV supervisor and company supervisor must sign an agreement following the procedure established by the Career and Employment Office at UPV (Internships-UPV, 2021). Since 2017, this agreement obliges this internship period to be remunerated (VEE-UPV, 2017).

At present, due to the high offer in Food Technology and Food Engineering courses (official Bachelor and Master degrees, etc...), one of the main challenges of DEUTA is reaching students willing to enrol in this course. DEUTA curriculum and structure clearly differentiates from official degrees which makes this choice appealing; however, this information needs to reach potential applicants. For that purpose, several marketing strategies are used each year to reach future students (Fig. 1); these include posters, brochures, e-mailing, updating calls in the DEUTA-blog, or the use of social networks, among others.

3. Methodology used for analysing the university extension diploma in food technology experience

The data used for analysing the DEUTA experience has been collected using different tools. On the one hand, the UPV quality system collects the students’ opinion through a survey at the end of each course which enables to assess the management of the course by means of a 5-level Likert scale questionnaire. This questionnaire includes 15 items in which different aspects of the course are evaluated: from administrative and management issues, through promotion, schedule, teaching methodology and professional relationships. General satisfaction with the Diploma is also rated.

Besides this official survey, the present analysis includes an additional questionnaire, launched through Google Forms in June 2021, designed to identify the main reasons that encourage students to enrol in this Diploma, as well as their degree of satisfaction regarding achievement of these goals. As stated previously, the survey was anonymous and surveyed individuals were fully informed on the purpose of the questionnaire. The questionnaire contained the following questions, and it was e-mailed to students of the different DEUTA editions.

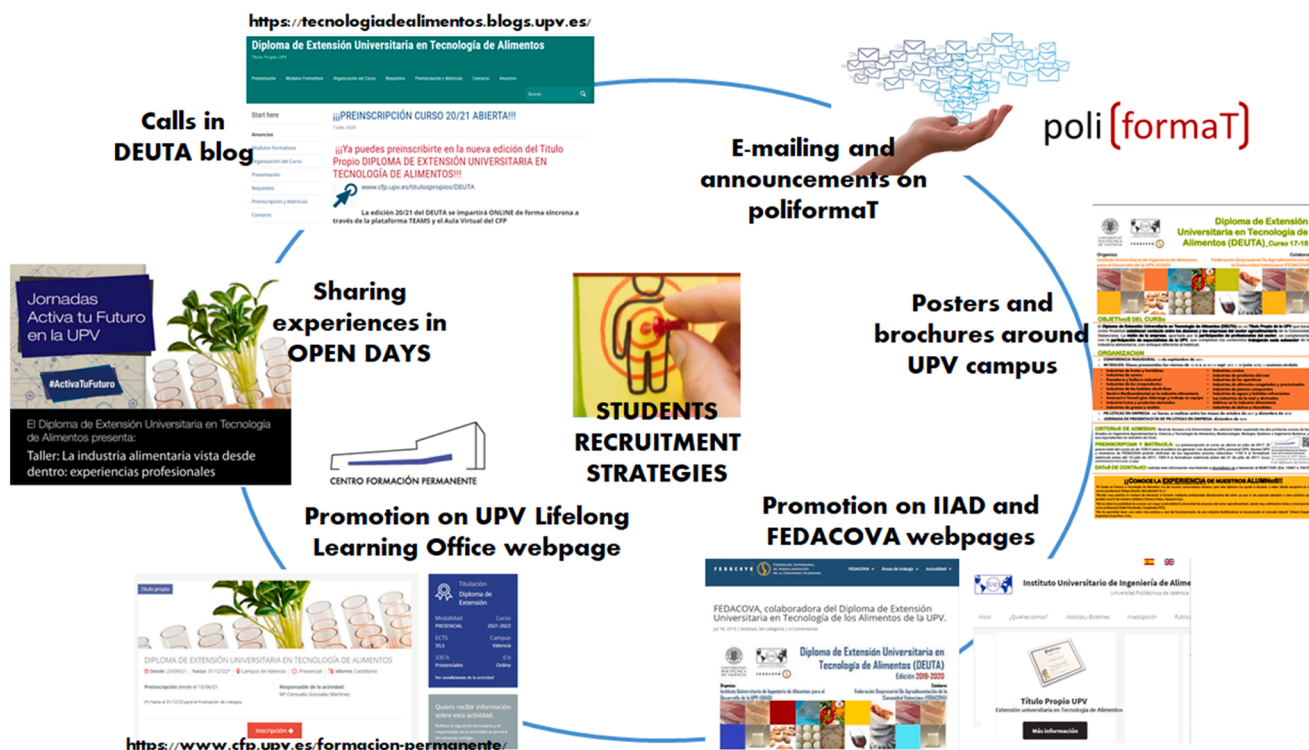


Fig. 1. Students’ recruitment strategies used to reach and inform potential DEUTA applicants.

- 1) Which was your main motivation to enrol this diploma?
- Improve my employability
 - Redirect my professional profile
 - Broaden knowledge in food technology
- 2) I consider this Diploma contributed to my employability/to redirect my professional profile (Answer: 5-level Likert scale)

In addition, the reports on the internships handed over by students at the end of each edition were also revised to extract useful information which could serve for the analysis of this experience and the students' opinion. These reports (Fig. 2) had the following sections which had to be developed in 10 pages maximum: (1) Student/supervisors/company information (2) Abstract: short summary of the internship period (3) Introduction: description of company characteristics and activity (4)

Objectives and justification of the tasks on the context of the internship and the diploma (5) Description of the tasks and results (diagrams, processes, planning, schedules and results obtained) (6) Conclusions: main conclusions derived from the internship experience, both from the scientific-professional and from the personal point of view (7) Student and supervisors' signatures.

Finally, the opinion of companies' experts regarding their participation in the diploma was assessed through a survey (Google Forms) in which both, their perception on supervising DEUTA interns (Section A) and their experience regarding their contribution to DEUTA curriculum by lecturing in modules (Section B), was assessed. The questionnaire contained the questions below, and it was e-mailed to companies participating in the last edition of DEUTA (year 2021–22).

SECTION A: COMPANIES SUPERVISORS OPINION ON INTERNSHIPS.

Student name and surname:	<i>Company logo</i>
Company:	
University supervisor:	
Company supervisor:	
Internship period: From _____ To _____	

Maximum 10 pages

ABSTRACT
Short summary of the internship period

1. INTRODUCTION
Describe the company characteristics and activity.

2. OBJECTIVE
Define the objectives of the internship. Justify the tasks on the context of the internship and the diploma.

3. DESCRIPTION OF THE TASKS DEVELOPED
Describe and comment on the tasks undertaken during the internship. Include any diagram, processes, tasks planning or schedules, as well as the results obtained. Include figures with a foot caption, and tables with a caption at the top.

4. CONCLUSIONS
Extract the main conclusions derived from your internship experience, both from the scientific-professional point of view and from the personal one. Give your opinion on the knowledge and capabilities acquired, but also on the relationship with other employees and other departments.

Signature: _____ Signature: _____ Signature: _____

UPV SUPERVISOR STUDENT COMPANY SUPERVISOR

Fig. 2. Structure of the internship report delivered by students at the end of the internship period and before the presentations closing day.

- 1) University interns enrich our organization (Answer: 5-level Likert scale)
- 2) University interns are able to work independently (Answer: 5-level Likert scale)
- 3) Training a university intern is very time consuming (Answer: 5-level Likert scale)
- 4) Training a university intern is time consuming but benefits both the company and the student (Answer: 5-level Likert scale)
- 5) We are more likely to hire applicants who have had internship experience (Answer: 5-level Likert scale)
- 6) Indicate a positive and a negative aspect regarding your experience in supervising DEUTA interns (open-ended question)

SECTION B: COMPANIES' PARTICIPANTS OPINION ON LECTURING IN MODULES.

- 1) DEUTA students have a good attitude towards companies' experts (Answer: 5-level Likert scale)
- 2) I believe I am teaching DEUTA students from a different perspective (Answer: 5-level Likert scale)
- 3) DEUTA students hold different backgrounds, which makes it difficult to run the session (Answer: 5-level Likert scale)
- 4) DEUTA students hold different backgrounds, which enriches the class atmosphere (Answer: 5-level Likert scale)
- 5) Regarding my experience in DEUTA as a company expert lecturer I would like to add (open-ended question)

4. Results and discussion

4.1. Monitoring the diploma since academic year 2004/05

The number of students enrolling DEUTA since 2004/05–2020/21 is shown in Fig. 3. In these years, the diploma has gone through different stages which implied, for instance, modifying the maximum number of students accepted per year. In particular, the maximum number of students was initially set to 50 but was reduced to 25 since the academic year 2013/14 mainly due to the difficulties in finding internships for all the students enrolled in the program. Regardless the number of vacancies offered, an average of 46 % of the offer was occupied. It is to mention that the diploma had to be cancelled in the academic years 2007/08 and 2009/10 due to the decrease in the number of students interested in enrolling the course. These circumstances coincided with the years after the onset of the financial crisis of 2008/14 (Reina-Paz et al., 2012), and the loss of purchasing power. The opposite trend was

found in subsequent years, since the demand reached a maximum in the academic year 2010/11, this coinciding with the widespread increase in student enrolment in all Spanish universities (both public, private and online) in all degree programs (Reina-Paz et al., 2012). Such increase in higher education enrolment could partly be due to the restructuring of the higher education system in Europe (European Commission, 2018) which forced many individuals to take adaptation courses (from the former three-year degrees to the new four-year degrees); but also to the increase in the unemployment rate during the crisis and post-crisis period, with individuals having more availability to participate in continuing education programs and a need for redirecting their careers. In this sense, given that the food sector is the most important industrial sector in Spain and one of the drivers of the way out of the crisis, it is not surprising that the number of students enrolled in food-related studies increased. Nevertheless, even if the behaviour of the food sector has been remarkable as compared to other industrial sectors (FIAB, 2017), the reduction from 50 to 25 students as the maximum being enrolled each year has been maintained up to present. This suggests that other factors might have influenced the students' decision; in fact, the increased offer in post-graduate courses (mainly official master's degrees) after the Bologna process is one of the main reasons still having an impact on the number of students enrolled in DEUTA in recent years.

Data collected through the surveys revealed that students enrolled yearly in DEUTA are primarily students and former graduates of degrees taught at the UPV. This is mostly a consequence of them being the main recipients of the e-mailing sent by the UPV's Lifelong Learning Office and DEUTA teachers themselves, in addition to having more access to informational brochures and posters distributed throughout the campus.

A revision of DEUTA students background considering all editions evidenced that this was a course mostly taken by engineering undergraduates and graduates. In fact, 57 % of them had an engineering background: 49 % had completed or were following Agri-food engineering studies (the extinct studies of Agricultural Engineer and Agricultural Technical Engineer, which at UPV have a tradition on food industries intensification; or the current degree in Agri-food Engineering) and 7 % had a background in Chemical Engineering; in addition, another 24 % completed or were following other technical food-related studies (the extinct Bachelor degree in Food Science and Technology or the current degrees in Food Science and Technology). Finally, the remaining 19 % comprises students from other degrees such as Chemistry (5 %), Human Nutrition and Dietetics (3 %), Biotechnology, Oenology or Veterinary.

Regarding the gender, the diploma has been more demanded in most editions by female students. According to data provided by the Ministry

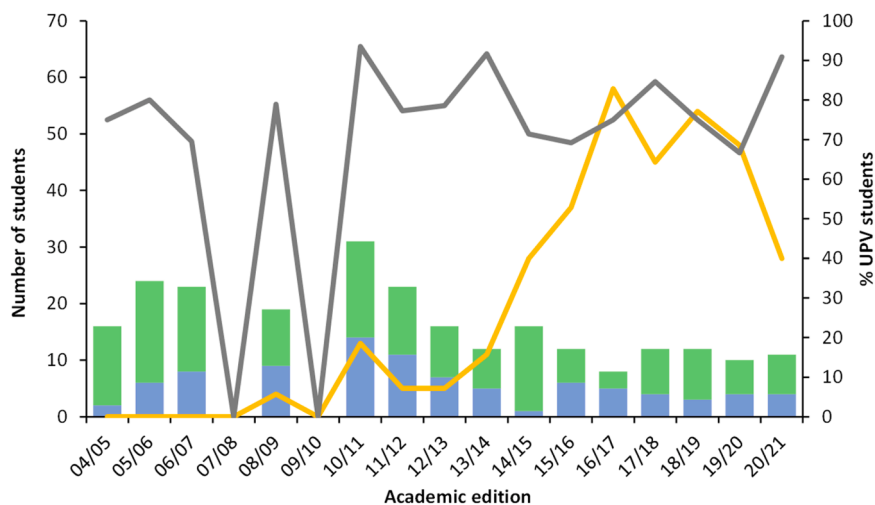


Fig. 3. Evolution in the number of male (blue bars) and female (green bars) students enrolled in the diploma, UPV- students ratio (grey line), and total students enrolled in single modules (yellow line).

of Education and Vocational Training of the Government of Spain (EDUCAbase, 2021) for academic courses from 2015/16–2020/21, women represented 66 % of the total number of students enrolled in Food Science and Technology at the UPV, while female represented 44 % in industrial Chemical Engineering. When considering all engineering and construction degrees taken at UPV, this percentage reduced to 31 % of females vs. 69 % of males. As indicated previously, the food and beverage industry is also a preferred option among female chemical engineer students to develop their careers (Prado, 2021). This evidences that, among technical undergraduates, the food sector is more appealing to women than men. Another trend observed is that the total number of students enrolled in technical food related studies has slightly increased, whereas the total amount of students enrolled in engineering and construction has decreased.

Although the offer has always included DEUTA modules to be taken individually, only 38 students selected this option between 2004/05 and 2013/14 academic years. In contrast, as evidenced in Fig. 3 (yellow line), enrolments in individual modules since 2014/15 increased to an average of 43 students per academic year and reached a maximum of 58 and 54 students in academic years 2016/17 and 2018/19, respectively. This suggests that individual modules are being perceived as a good continuing education option. In fact, participants enrolling individual modules are most often professionals who would like to specialize or update their knowledge in a particular food sub-sector. The demand for individual modules has remained quite homogeneous in the last years, “Additives in the Food Sector” being always among the most demanded ones probably due to its applicability to all companies and sub-sectors, and the need for updated knowledge in new, natural, or more sustainable additives.

5. Monitoring internships offer since 2013/14

As introduced previously, one of the problems this diploma has faced after the onset of the financial crisis in 2008 is the reduced number of internships offers from companies. Several difficulties have been identified in this sense: (i) companies’ reluctance to host students for fear of revealing their know-how to competing companies in a near future, (ii) obligation to pay students (remuneration requirements) and (iii) short period which implies a training that does not revert to the company. However, internships have also important advantages for companies such as tax deduction of students’ salary, or the opportunity they provide to test the capabilities of a future worker, at a lower cost.

In this regard, Fig. 4 shows a classification of the companies where DEUTA-students have carried out their internships in the last seven

academic years. Fruit and vegetables sector hosted most of the DEUTA students, whereas other sectors had a variable representation in each diploma edition; snacks, and meat and dairy industries being the most represented ones. This is not an unexpected result since Valencian Community is one of the most important European regions in the trade of fruits and vegetables (ICI Bussiness, 2020), for which this is a result of the socioeconomic context.

Internship reports revealed that the work and tasks performed by students while working in the companies were diverse. Tasks related to quality control, i.e. physicochemical and microbiological analysis of raw materials and intermediate and final products, together with those related to process control and improvement, were by far the most entrusted to students during their internships. Coordination between department in charge of this tasks is essential since quality loss or a safety risk is usually overcome with a modification in the process or process conditions; as well as any modification or improvement in the manufacturing process must ensure the final product meets quality and safety requirements. Verifying the cleaning and hygiene systems is another of the tasks commonly reported. The development of new products, document management or the verification and update of the company’s quality control system, represented the core in 6 %, 8 % and 4 % of the internships, respectively. Other tasks reported less frequently were the training of professionals and company workers, technical consultancy, internal audit, claims management or marketing issues. In general, internships improved students’ knowledge and competences on specific food process unit operations and the proper handling of process parameters to optimize process yield, reduce energy consumption, minimize waste generation; while ensuring product quality and safety, as well as consumers’ acceptance.

Students’ opinion on the internships was in all cases very positive. For many of them it was their first contact with the professional world and the first opportunity to put into practice the knowledge acquired in the classroom. Being aware of manufacturing problems, the internal running of a company (organization into departments, the Quality, Safety and Health and the Environment and Continuous Improvement policies) and the challenges the company faces in a daily basis is what stand out the most in their personal reports. Among soft skills, the ability to solve problems, permanent learning and working in multidisciplinary teams were identified as the most improved thanks to the internship period. On a personal level, students gained self-confidence and for some of them the internship implied the subsequent hiring by the company.

As evidenced, internship experiences provided onsite training and experience in food companies, which is line with the objectives of diploma, i.e. bridge the gap between academia and industry. In addition,

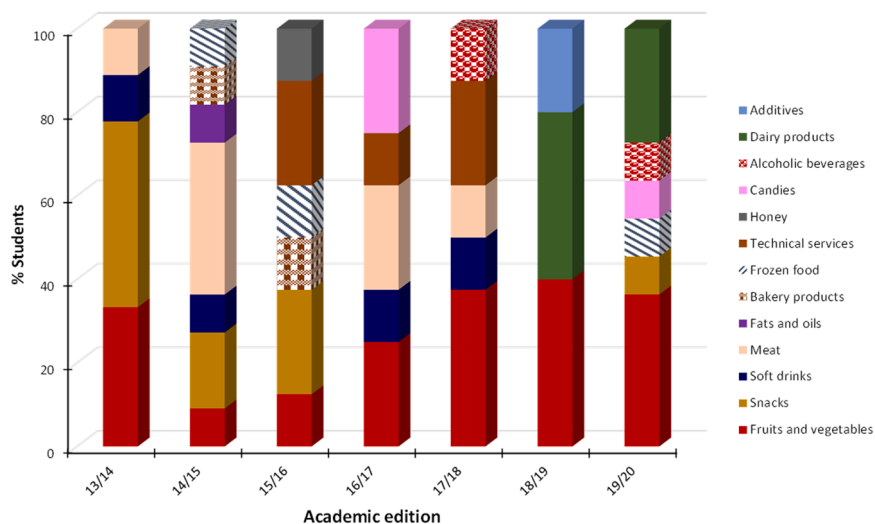


Fig. 4. Percentages of DEUTA students in each type of company for their internship/ Sectors where students have carried out their company internships.

participation in the different sub-sector modules also allowed students to interact with professionals of the food sector and learn from their experience, thus broadening their possibilities of success in the labour market. Moreover, the closing seminar session in which all DEUTA students participate, enhances contact with classmates and learning from their experience, which also contributes to expand knowledge and options. Finally, it is to mention that participation of both academics and professionals in each module strengthen bonds and boost collaboration projects between industry and academia.

Contact with professionals was especially affected by the onset of COVID-19 pandemic, which implied the closure of non-essential activities in march 2020. In fact, companies' reluctance to host students was intensified during this period, which mainly affected editions 2019–20 and 2020–21. In these years, due to the low company offers available for students, even null in the first months of the pandemic, the diploma managers were forced to offer an alternative to complete the internship period, which consisted of preparing a supervised technical report. Not only internships were affected by the pandemic, but it also had an impact on other onsite activities. In fact, modules had to be taken completely online at the end of year 2019–20 and during the whole 2020–21 edition. Online activities negatively affected interaction with professionals and other classmates, as deduced from companies' representatives and students' opinion. In addition, online offer did not have a positive impact on student enrolment. This reinforces the idea that direct contact with company experts, together with internships, are the most valuable components of the course. Consequently, in subsequent years, DEUTA diploma was again fully offered onsite.

6. Students' opinion and satisfaction on the diploma and its impact on employability

The UPV quality system survey (see materials and methods section) is answered by participants at the end of the academic year. As said, it includes 15 specific questions and a final general question on global satisfaction ("My expectations on this Diploma are satisfied"). Yearly, the survey has been answered by an average of 75 ± 20 %. As for students' global satisfaction throughout the 15 editions (Fig. 5), this has been graded higher than 5/10 in all cases. In fact, except for editions 2012/13 and 2014/15, the average mark has been 7.4 ± 0.7 .

Answers to other selected questions of the UPV quality system survey

are shown in Fig. 6. These questions have been selected for the present analysis considering their relevance for the purpose of this paper. The average value (\pm standard deviation) of the scores given to each question are shown, considering the 15 editions. Most of the participants enrolling the course are students taking other official courses (bachelor or master degrees) but also young professionals. Both have other onsite duties and tight schedules. In response to this need, DEUTA modules are scheduled on Friday afternoon as described previously. According to the results of the survey, most of the students agreed with this schedule and found it compatible with their other duties. Among selected questions, the question that scored highest was related to students considering the course useful for their professional career. This result implies that, after graduating with this Diploma, student's perception is that the course significantly contributes to their professional skills and development, which is in line with the objectives of the course and contribution to students' employability. Other issues such as teaching methodology and satisfaction with complementary activities such as short visits to companies are also given a score higher than 7/10. Finally, the last question analysed is focused on the contribution of the Diploma in creating useful professional relationships. In this case, the score obtained is slightly lower but still near to 7/10. It needs to be considered that this is the answer that had a higher variability, as measured by the standard deviation of the results. This suggests this question might be more influenced by personal experiences. Besides, results of editions 2012/13 and 2014/15 scored significantly below the average, coinciding with the editions in which global satisfaction with the Diploma was the lowest. The average of the rest of editions scored more than 7 and up to 8.6 regarding professional relationships as a result of participating in this Diploma.

Results of the additional survey designed to evaluate motivation and employability success, are summarized in Fig. 6. This survey was launched in June 2021 by the DEUTA coordinators with the aim of learning students' opinion after some years of having taken the diploma. The link of the survey was e-mailed to former students and it was answered by 58 students who participated in the diploma in editions from 2004/05–2019/20. This allowed to obtain information of the impact of DEUTA on the short, medium, and long term, since a wide sample distribution was available: 46.3 % of the answers were from students who took the diploma 10–18 years ago (editions 2004–05–2011–12); whereas 53.7 % of the answers were of students

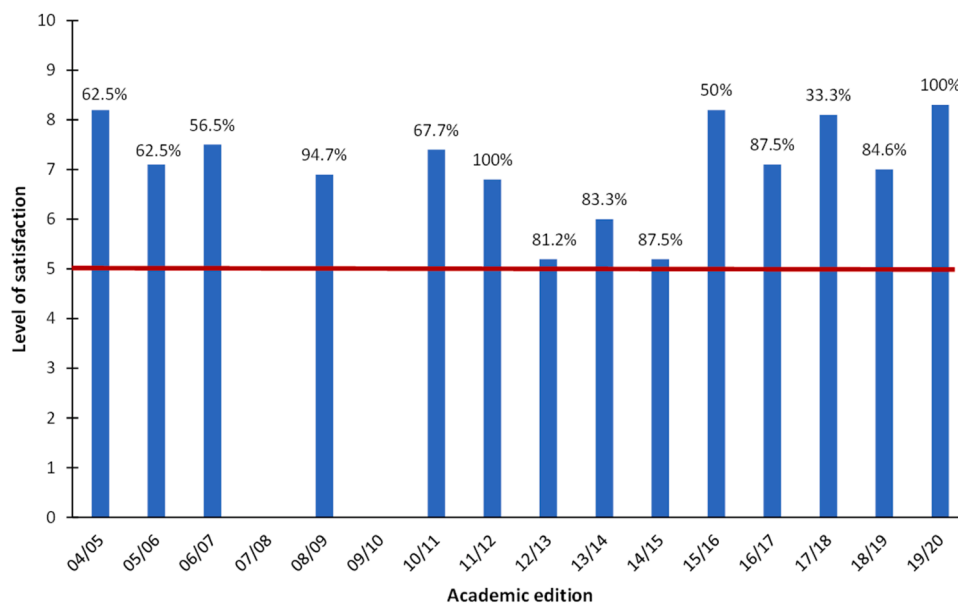


Fig. 5. Students' level of satisfaction on the food technology course in each edition. Red line is the minimum grade to overpass their satisfaction. Numbers on each bar represent the percentage of students who answers the survey.

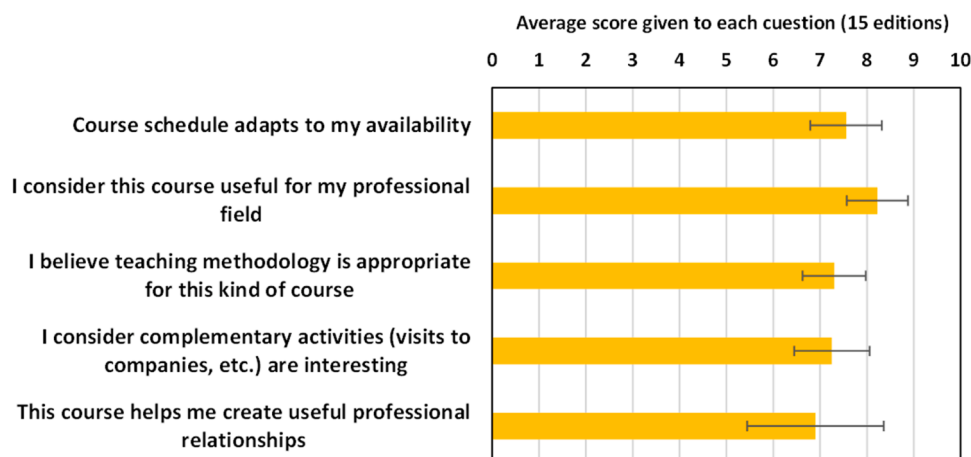


Fig. 6. Score given by students to questions of the UPV quality survey. The values given are the average (\pm standard deviation) of the answers collected through 15 years.

taking the course in the last ten years, 24 % corresponding to the last 5 editions.

As for the motivation to enrol this diploma, more than half of the students declared their main motivation was related to job-oriented objectives (55.1 %), either getting closer to the labour market (44.8 %) or redirecting their professional profile (10.3 %). The rest of participants (44.8 %) reported having enrolled the degree to broaden their knowledge in food technology or complement their skills (Fig. 7). This result is in line with the structure of the course in which both professional skills and academic knowledge are provided. It needs to be considered that surveyed students were asked to choose only one of the options with the aim of identifying their main motivation, but of course both job-oriented objectives and knowledge ones are complementary, as evidenced.

Regarding students' perception on the diploma contribution to their employability, 44.8 % confirmed that the degree helped them access the labour market or redirect their professional profile to a remarkable extent (quite significantly and very significantly); 13.5 % gave a neutral answer; 20.7 % reported it slightly contributed to their employability success (Fig. 7). Finally, 13.8 % declared the course not having contributed to their employability. No relationship was found between expectations and degree of satisfaction regarding effective contribution to their employability. Likewise, no relationship was found between the year in which the course was taken and perception on employability. This suggests that personal experiences along these 15 years have been varied and it is difficult to extract a general trend.

To our mind, results of both surveys evidence that DEUTA graduates value very positively having taken this diploma and consider it has

contributed significantly to their professional careers, not only in the short term, but also in the medium and long term.

7. Opinion of company experts on internships and their contribution as DEUTA lecturers

Opinion of company professionals on their participation in DEUTA regarding both internships and modules is summarized in Table 2. The survey was answered by 18 company representatives participating in the 12 modules of the last DEUTA edition (year 2021–22).

Most supervisors who answered the survey agreed (44 %) or strongly agreed (44 %) that university interns enriched their organizations. As stated by Ismail (2018), benefits for host organizations include the possibility of undertaking secondary or value-added projects and having a good source of labour during busy periods at a relatively low cost. However, according to answers to the open-ended question "Indicate a positive and a negative aspect regarding your experience in supervising DEUTA interns", students' training, their attitude towards work, their will to learn and their short-term expectations, were the most outstanding aspects. Supervisors generally considered that training an intern is very time consuming; however, there was quite a diversity of opinions as evidenced by answers to this question (22 % declared to disagree, 22 % were neutral, 44 % agreed, and 11 % strongly agreed). Opinions were also diverse regarding whether "university interns are able to work individually" or not. To explain this, one could refer to personal abilities and skills, which varied from one individual to another. In contrast, there was quite a consensus (78 %) on the fact that training a university intern, despite being time consuming, benefits both

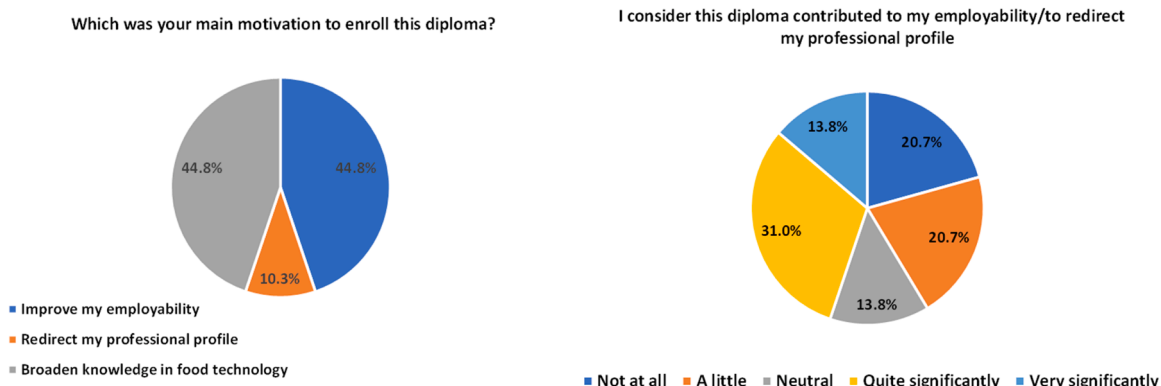


Fig. 7. Answers to the questionnaire on motivation to enrol the diploma and perception of impact on employability.

Table 2

Companies' participants opinion on DEUTA regarding internships and lecturing in modules. Results are given in percentage (N = 18).

<i>INTERNSHIPS</i>	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
University interns enrich our organization	0 %	0 %	11 %	44 %	44 %
University interns are able to work independently	0 %	33 %	33 %	33 %	0 %
Training a university intern is very time consuming	0 %	22 %	22 %	44 %	11 %
Training a university intern is time consuming but benefits both the company and the student	0 %	0 %	22 %	56 %	22 %
We are more likely to hire applicants who have had internship experience	0 %	11 %	33 %	33 %	22 %
<i>MODULES LECTURING</i>	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
DEUTA students have a good attitude towards companies' experts	0 %	0 %	0 %	39 %	61 %
I believe I am teaching DEUTA students from a different perspective	0 %	0 %	0 %	33 %	67 %
DEUTA students hold different backgrounds, which makes it difficult to run the session	22 %	33 %	44 %	0 %	0 %
DEUTA students hold different backgrounds, which enriches the class atmosphere	0 %	0 %	11 %	50 %	39 %

the company and the student. Benefits for interns include improving their employability, as evidenced by 55 % of the company supervisors declaring to be more likely to hire applicants who have had previous internship experience.

With regard to companies' participants as lecturers in DEUTA modules, all of them agreed or strongly agreed on the fact that DEUTA students have a good attitude towards professionals participating as lecturers. In line with this, all surveyed individuals believed to be contributing to students learning from a different perspective (67 % strongly agree, 33 % agree). On the other hand, professionals' opinion on the different backgrounds held by DEUTA students was positively assessed: while none of them thought this fact made it more difficult to run the sessions, most of them declared this characteristic of DEUTA students profile enriched the class atmosphere (89 % either agreed or strongly agreed). With regard to the open-ended question "Regarding my experience in DEUTA as a company expert lecturer I would like to add...", professionals declared the experience to be "very interesting", "gratifying and enriching", and they insisted on "students' attitude to be very active". Other comments were "very positive experience, both due to the organization of the formative activity and students interest on the topics delivered", "an experience which enriches both the teacher/professional and the student, who has the possibility to learn on the sector from a different perspective", "it is very enriching for me to make an effort to properly transmit the company experience to students", or "the experience is of particular interest when it is completed with a company internship". Other participants simply declared to be satisfied with the

experience.

As seen, professionals participating in DEUTA were in general very satisfied with the diploma, both regarding internships and lecturing in modules. This result contrasts with companies' reluctance to host interns, as discussed before in this paper, a trend which has been confirmed since 2008. To our mind, this demonstrates that diplomas or courses such as DEUTA help establish successful bonds between industry and academia and strengthen relationships, which may be exploited to boost graduates' employability.

8. Conclusions

Higher education institutions can attract potential students, enhance their reputation and visibility, and strengthen bonds of collaboration between the academic world and industry by means of courses which include qualified professionals' experience and internship programs in their curriculum. University Extension Diploma in Food Technology (DEUTA) at UPV is a clear example of this, with more than fifteen editions with positive student ratings. Through these years, it has been noticed that the economic situation has significantly influenced the number of students enrolled, but still students' general satisfaction on the course after each edition has been good. Similar encouraging results have been evidenced for other aspects, from the course structure to the professional network built. Regarding students' perception on to which extent DEUTA contributes to employability in the medium and long term, most of the surveyed individuals perceived it helped them access the labour market or redirect their professional profile to some extent. Companies experts' opinion on the diploma was also very satisfying, regarding both their participation in the modules as lecturers, and the contribution of DEUTA students to their companies as interns. However, and in spite of the good results regarding the opinion of both students and professionals about DEUTA, recruitment of students has become more difficult over the years, and companies' reluctance to host interns has increased. This contrast between opinion and facts suggests that new strategies need to be designed and put in practice in order to reach both students and companies.

The present analysis concludes that non-official diplomas such as DEUTA in which both academics and company representatives take part and internships are given special relevance, may be a good approach for bridging the academia-industry gap and boosting employability, thus effectively contributing to the European Employment Strategy. This experience focuses on the food sector, but the results obtained may be extrapolated to many sectors other than food, such as the chemical, environmental or biotechnological ones. Sharing this approach may help lecturers and institutions organize similar courses or diplomas to prepare competent and efficient technical workers, and help students and professionals orient their training and continuing education choices.

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Ethical statements

Data collected in the present study through surveys or questionnaires has been gathered under informed consent of individual participants, ensuring anonymity and confidentiality.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Data are available from authors upon reasonable request.

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