UDC 37
DOI 10.54151/27382559-2022.2b-106

TEACHING METHODOLOGY

PROMOTION ACADEMIC ENTREPRENEURSHIP THOUGHT IN BIOPRODUCTS PROBLEM-BASED LEARNING METHODOLOGY: A CASE STUDY

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Entrepreneurship and innovation are priority objectives for the development and increase of economic competitiveness. However, they need a priority intervention and especially directed to activities of a business nature, going beyond the fields of investigation and science. The search for professionals with different skills to overcome the current and foreseen challenges is relevant in the bioproducts sector. Problem-based learning (PBL) is described as an instructional approach, which promotes interdisciplinarity and critical thinking, with the potential to meet current challenges. This article describes a proposal to align the PBL with an innovation program and contest, to be integrated into a master's degree in science and technology in bioproducts (MDSTBio) to promote academic entrepreneurship. The alignment of the PBL with the program and contest could allow the development of innovative products with a view to solving problems faced by the bioproducts sector. The PBL strategy could allow students to mobilize knowledge from several curricular units of MDSTBio for the development of different deliverables to participate in the innovation programs and contests. This way, it could be possible to promote innovation in the bioproducts sector, stimulating the entrepreneurial spirit among higher education students, and understand its potential for replication and mobilization of skills acquired in different bioproducts courses.

Keywords: entrepreneurship, problem-based learning, bioproducts, learning methodologies.

Introduction. Bioproducts, or bio-based products, are those produced from biomass, that is, any type of organic material available on a renewable basis from agriculture (for example: from crops or harvest residues, dry grains, wood, leaves) and/or food processing (by-products, waste and out-of-spec materials). Typically, bioproducts are divided into three categories: bioenergy (e.g. bioethanol, biodiesel), biomaterials (e.g. bioplastics, biofibers) and biochemical (e.g. lubricants, vaccines, soap) [1].

An assessment carried out by the European Commission in 2014 indicated that biofuels and bio-based products represent approximately 57 billion euros in annual revenue and involve around 300,000 jobs. According to forecasts, the bio-based share of all chemical sales would increase to 12.3% in 2015 and 22% in 2020, with a compound annual growth rate of around 20% [2].

Thus, it is not surprising that the Bioeconomy (an economy based on bioproducts) is on the political agenda of the Commission for the Environment, Climate, Employment, Growth, Equity and Democratic Change and that it continues to be part of the Research and Innovation Agenda. Investing in research and innovation helps us to compete worldwide and to ensure the European social model, generation added value by encouraging collaboration between research teams from different countries and disciplines, which is central to real scientific progress [3].

Given the importance of innovation for competitiveness in the agri-food sector, it is necessary to explore different methodologies to promote innovation.

Problem-Based Learning (PBL) is focused on building knowledge through long and continuous study work, the purpose of which is to answer a question, a challenge, or a problem. Thus, an approach that could emphasize innovation in a learning setting at higher education institutions [4]. PBL emphasizes activities carried out through projects, whose focus is the collective construction of interdisciplinary knowledge in which students become protagonists, that is, they learn by doing in cooperation with other students. Students need to cooperatively plan their team's actions as they progress in solving the problem, developing an action plan, and beginning to develop a description or guidelines for developing their products [5].

This paper aims to present and describe a model for the implementation of the PBL methodology in a master's degree in science and technology in bioproducts (MDSTBio) with an alignment with an innovation program and

contest looking forward to promoting academic entrepreneurship in the agri-food sector.

Methodology. A case study methodology was adopted with the purpose to describe the facts as they happened, to narrate situations, to provide knowledge about the phenomenon studied and to prove or contest the effects and relationships present in the case. A case study is not just the methodology it adopts, but the object that has to be unique, specific, different and complex [6]. According to Dooley [7] researchers from different areas increasingly use the case study's research method to develop theory, produce a new theory, contest or challenge the theory, to explore or describe an object or phenomenon or, still, to explain a situation.

The aim was a holistic approach that considered multiple aspects relevant to an educational innovation process in the context of the teaching of food sciences, namely, organizational, sociocultural, technological, pedagogical, and methodological aspects. In this sense, the case study should be able to involve the various actors in the innovation process, consider the various points of view and allow data analysis from multiple perspectives [8].

In this way, the proposed model was developed around the MDSTBio and the Innovation Track Program and Contest (ITPC) during three annual editions that took place during three school years from 2017/2018 to 2019/2020, opened to teams of students from post-graduation studies in food science and technology, in institutions from the Porto Region, Portugal. As indicators of success, we registered the number of students involved, projects in competition and prototypes or projects launched.

Results and discussion. Case study description: Innovation Track Program and Contest.

The main goal of the Program was to select Ideas for Innovative Products and Services and support their presentation, to the economic and social fabric and to the market. It was intended that Work Teams were created and innovation plans were developed that included, as appropriate, an analysis of technical and scientific feasibility, a proof of concept, a prototype, and a business project. Projects considered to be of higher quality will be awarded in a Contest as assessed by Judges. The Faculty of Biotechnology – Universidade Católica Portuguesa had a set of partners for the execution of the Program. It involved the development of Products and Services based on knowledge and technologies applicable to the agri-food sector.

The call for the ITPC was open to all teams that apply with a Product or Service Idea with application to the agri-food sector and whose team preferably includes three or more elements. The Program and Contest is intended for Teams that involve graduated students with competences at a Higher Education Level in the areas relevant to the development of Products and Services applicable in the referred areas. Participants from any Higher Education Institution could participate.

The ITPC had 4 phases: Admission, Development of Innovation Plans, Presentation of Products and Services in Media and Events, and Attribution of the BIOTEC Awards (EUR 2000/ each).

The ITPC implementation model (Figure 1) starts with the ideation of an innovative product or service for the agri-food sector. Then, it goes through a development phase of three deliverables: product specifications, business plan, and prototype. Finishing in the evaluation phase, where the deliverables are evaluated by the judges of the contest that would award prizes to the winners.

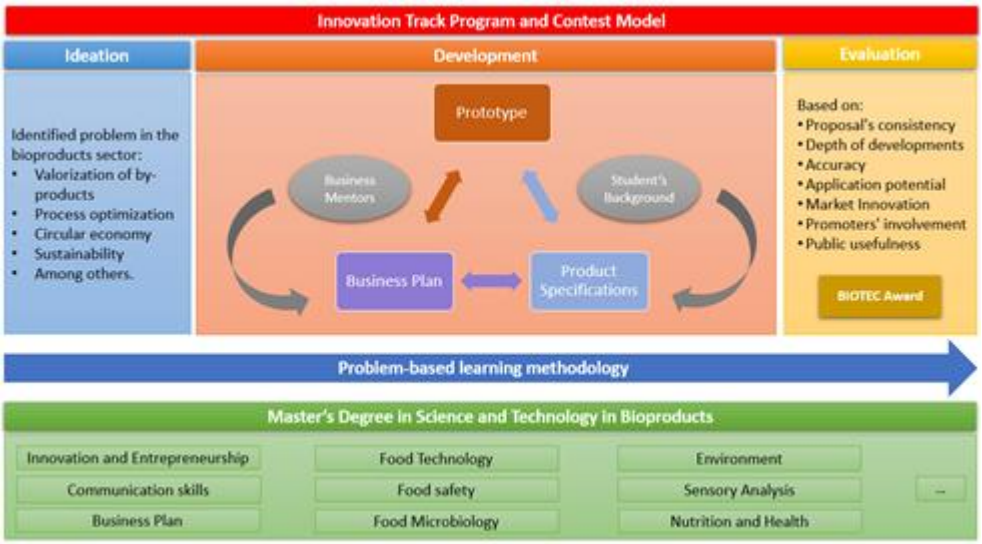

Figure 1. Alignment scheme of the Innovation Track Program and Contest with the Master's Degree in Science and Technology in Bioproducts thought a problem-based learning methodology.

In the ideation phase, participants had to think about an innovative product or service that would solve some problem identified in the agri-food sector, for example: valorization of by-products, process optimization, circular economy, sustainability, among others.

In the development phase, participants had to develop three deliverables. The “product specifications” deliverable should contain technical data: product composition, manufacturing process (process, safety, materials, providers, and facilities and equipment), storage (shelf life and storage conditions), packing (label and communication, materials and design), distribution and logistics, innovative aspects, and eco-innovative aspects. In this way, students were encouraged to use previous knowledge about the development of new products, relating a set of subjects previously taught in their background and/ or being teaching at the master's level (e.g., food safety, food quality, packaging, sensory analysis, etc.), since the contest was aimed at students at master's level in the area related to food science and technology. The second deliverable "business plan" aimed to evaluate the product or service from the market point of view and included aspects such as: market analysis (analysis of consumption trends, competition analysis, targeting and positioning), business strategy (business model, validation by potential customers), “Go to market” plan (development plan, marketing plan), and financial forecast (profit and loss account, business indicators). For the development of this deliverable, the participants were accompanied by business mentors who guided them and provided them with a more realistic perspective of the business fabric. Finally, the third deliverable “prototype” corresponded to a finished version of the product or service, that is, ready to be sold. Participants were encouraged to participate in other contests and events that made it possible to present their products or services to the business community in order to launch their products on the market.

The three deliverables have a dynamic interaction, for example, the business plan influences the prototype insofar as if the production of it is not economically viable, it will have to be changed and the product specifications can also be changed having to be found new transportation alternatives, or raw materials, among others, which in turn influence the business plan.

In the evaluation phase, the three deliverables were evaluated by the judges according to the following criteria: consistency of proposals, depth of developments, accuracy, application potential, innovation in the respective market, the involvement of promoters and public usefulness. After sorting the score assigned to each team, BIOTEC Awards of EUR 2000 were given to the best classified.

In academic year 2017/2018, of a total of 54 students, 37 (12 teams) decided to participate in the ITPC. In the following academic year, of a total of

45 students, 22 (five teams) decided to participate in the ITPC. And in the academic year 2019/2020, of a total of 35 students, 17 (five teams) decided to participate in the ITPC. Of a total of 14 prizes awarded under the ITPC.

The MDSTBio integrates core engineering principles with specialist topics in the field of bioresource processing. Students of this master's degree will gain enhanced technical and research skills and also develop entrepreneurial acumen sought by a broad range of industries, especially bio-based industries, both locally and internationally. This course comprises a set of curricular units related to the food industry such as food technology, food microbiology, packaging, environment, nutrition and health, innovation and entrepreneurship, business plan, marketing, among others.

The PBL could be implemented in such a way that the development of products by students was integrated and mobilized the knowledge acquired in different curricular units according to the needs of each challenge associated with food innovation. Some curricular units were identified as core units for the PBL approach such were: sensory analysis; advanced food technologies; microorganisms and food safety; development of new products and processes; packaging; food engineering and innovation project; management, innovation, and marketing.

For example, one of the stages of the development of a new product is the study of packaging, thus in the curricular unit "packaging", students studied and designed the best suited solution; in the curricular unit "sensorial analysis", a consumer study was carried out to have insights about the new product acceptance.

In general, this alignment could allow some advantages for teachers and students: a holistic orientation for professional practice; consolidation of knowledge by the multidisciplinary approach; development of skills to solve problems, facing "real" problems; the increased interaction between students and teachers; the work autonomy in the search for knowledge; and finally, it allows the student to assume more responsibilities and face external players [9, 10].

The participation in ITPC could provide opportunities for students to develop a prototype, a product specification, and a business project, combining different components of food science, management, and communication/ marketing, taught through the PBL. The instruction could go from the didactic lecture to the application in the real world of the principles of management in the simulated entrepreneurial activity. These benefits could be taken

advantage of by the participation of MDSTBio students in these types of contests and programs. In other studies [11-14], the project's work resulted in high levels of student engagement, improved critical thinking and problem-solving skills, and improved collaborative skills.

For the best implementation of the PBL on MDSTBio it is important to establish partnerships with business mentors or enterprises who could follow students in the development of their projects throughout the academic year, providing them with a closer look at professional reality.

Conclusion. From the described case it was possible to highlight key positive impacts of the alignment of the MDSTBio with an innovation program and contest throught PBL methodology, and some issues and challenges that would allow further developments and results.

With the challenge proposed under the Innovation Track Program and Contest, it was possible to observe a meaningful and contextualized learning, where students could create and execute their innovation projects in the bioproducts sector, where they could develop skills and competences that will be extremely important for the development of their profession, with the expectation of having a positive impact on the bioproducts economic tissue.

ԱԿԱԴԵՄԻԱԿԱՆ ՁԵՌՆԱՐԿԱՏԻՐԱԿԱՆ ՄՏՔԻ ԽԹԱՆՈՒՄ՝ ԽՆԴՐԱՀԵՆՔ ՈՒՍՈՒՑՄԱՆ ՄԵԹՈԴԱԲԱՆՈՒԹՅԱՄԲ. ԻՐԱՎԻՃԱԿԱՅԻՆ ՈՒՍՈՒՄՆԱՍԻՐՈՒԹՅՈՒՆ

Օլիվեիրա Լ., Քարդոսո Է.

Ձեռնարկատիրությունը և նորարարությունը տնտեսական մրցունակության զարգացման և բարձրացման գերակա նպատակներ են: Այնուամենայնիվ, նրանք առաջնային միջամտության կարիք ունեն և հատուկ ուղղված են գործնական բնույթի գործողությունների, որոնք դուրս են գիտական ուսումնասիրությունների ծիրից:

Ընթացիկ և կանխատեսելի խնդիրների լուծման ու հաղթահարման համար որոշակի հմտությունների ու կարողությունների տեր մասնագետներ են անհրաժեշտ կենսամթերքների սեկտորում:

Խնդրահենք ուսուցումը նկարագրվում է որպես ինստրուկցիոնալ մոտեցում, որը խթանում է միջգիտակարգային կապերը՝ նպաստելով քննադատական մտածողության զարգացմանը՝ ընթացիկ խնդիրների լուծման համար: Սույն հոդվածն անդրադարձ է խնդրահենք ուսուցման մագիստրոսական ծրագրային ներդրմանը կենսամթերքի ոլորտում՝

ակադեմիական ձեռնարկատիրության խթանման համար: Նշյալ ուսուցումը հնարավորություն է տալիս զարգացնել նորարարական արտադրանք՝ նպատակ ունենալով լուծել այն խնդիրները, որոնց բախվում է կենսամթերքների ոլորտը: Սույն մոտեցմամբ ռազմավարությունը ուսանողներին ընձեռնում է հնարավորություն՝ մոբիլիզացնելու գիտելիքները մի քանի MDSTBio ուսումնական ստորաբաժանումներից: Այսպիսով, այս ուսումնառությամբ հնարավոր է խթանել նորարարությունը կենսամթերքների ոլորտում, բարձրացնել ձեռնարկատիրական ոգին բարձրագույն ուսումնական հաստատություններում սովորող ուսանողների շրջանում և հասկանալ վերջինիս ներուժը կենսամթերքների տարբեր դասընթացներից ձեռք բերված հմտությունները բազմապատկելու և մոբիլիզացնելու համար:

Բանալի բառեր. ձեռնարկատիրություն, խնդրահենք ուսուցում, կենսամթերք, ուսուցման մեթոդներ:

СТИМУЛИРОВАНИЕ АКАДЕМИЧЕСКОГО ПРЕДПРИНИМАТЕЛЬСКОГО МЫШЛЕНИЯ С ПОМОЩЬЮ МЕТОДОЛОГИИ ПРОБЛЕМНОГО ОБУЧЕНИЯ: СИТУАЦИОННОЕ ИССЛЕДОВАНИЕ.

Оливейра Л., Кардосо Е.

Предпринимательство и инновация - приоритетные цели в развитии и повышении экономической конкурентноспособности. Однако они нуждаются в первостепенном вмешательстве и направлены на действия практического характера, которые остаются за пределами научного исследования.

Для решения и преодоления текущих и предсказуемых задач необходимы специалисты, наделенные определенными умениями и навыками в сфере биопродуктов.

Проблемное обучение описывается как учебный подход, который стимулирует междисциплинарные связи, способствуя развитию критического мышления для решения текущих задач.

Данная статья ссылается на внедрение проблемного обучения в программу магистратуры для стимулирования предпринимательства в академической сфере.

Указанный вид обучения дает возможность развитию инновационной продукции с целью решения тех проблем, с которыми сталкиваются в сфере биопродуктов.

Данная стратегия дает студентам возможность объединить знания из нескольких учебных источников, основанных на MDSTBio.

Таким образом, с помощью этого обучения возможно стимулирование инноваций в сфере биопродуктов, повышение предпринимательского духа среди студентов высших учебных заведений и выявление потенциала последних в повышении и мобилизации навыков, приобретенных на различных курсах по биопродуктам.

Ключевые слова: предпринимательство, проблемное обучение, биопродукт, методы обучения.

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Received by the editorial office on 20.10.2021
Reviewed on 27.12.2021