

**Louvain School of Management**

# **Teaching models in innovation education based on programs mapping**

Author: KELLER Lyne  
Supervisor: GAILLY Benoît  
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By signing this declaration, we affirm that the content of this master's thesis reflects our original work, augmented by the responsible use of AI.

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# Chapter 1

## Introduction

### 1.1 Context

The number of innovation education programs has increased worldwide over the last ten years. This increase highlights a significant change in attitudes. Teaching innovation has gone from being a passing trend to an essential foundation of our education systems. To meet the challenges of the 21st century, it is no longer a choice but a necessity to embrace innovation in education (Chandra *et al.*, 2020). This evolution in education has not happened without reason: it is a direct response to the changes in our world and the evolving needs of learners. We live in a world defined by rapid technological advances, the global interconnection of ideas and the need to find creative solutions to complex problems. Education must adapt accordingly.

Moreover, Sharma *et al.* (2022) highlights the importance of innovation even more after the Covid-19 pandemic. This pandemic has encouraged innovation to mitigate its negative effects. The overall performance of each country has depended heavily on the efficient cooperation, exchange of ideas, and open innovation between government agencies, academic and research organizations, and the business sector (Sharma *et al.*, 2022).

Unlike entrepreneurship, where there are directories of various educational programs, the field of innovation education lacks a centralized repository detailing the various approaches used to teach innovation. This gap poses a challenge for educators and institutions seeking to implement or improve innovation-based curricula.

### 1.2 Objective

The aim of this thesis is to map programs to identify major trends in the form of a directory enabling innovation programs to be classified based on three criteria.

- The audience which identified the target participants and the stakeholders.
- The goal of the program which identified the specific outcomes intended when the audience take part to this program.
- The format which is the structure and the delivery method of the program.

At the end, the aim of this thesis is to provide recommendations that offer practical advice to those wishing to teach innovation.

### 1.3 Methodology

This work begins with a review of the literature on the various aspects deemed relevant to the work. This literature review follows the same logic as that carried out by Fayolle and Gailly in the article “Teaching models and learning processes in entrepreneurship education”. Indeed, this work is based on that article. This part is followed by a proposed directory for classifying innovation programs.

Then, the practical part of this thesis includes a qualitative method carried out on brochures from different innovation programs. To identify innovation education programs, we used an approach based on online searches. We employed a variety of relevant keywords to maximize the scope of our search. These keywords included terms such as “innovation education program,” “innovation courses,” “entrepreneurship training,” “creativity education,” “creativity learning,” “executive programs on innovation,” etc. Searches were conducted on search engines such as Google. We then examined each brochure and extracted detailed information on the programs available, including course descriptions, pedagogical objectives, and target audiences.

This approach enabled us to compare the elements from the state of the art and those from the brochures. To enrich our understanding and ensure a diverse perspective, we conducted two interviews as part of this thesis. The interviews were conducted in a semi-structured format. Each interview was recorded with the consent of the participants to ensure accurate data capture. The experts' perspectives on the directory and suggestions were incorporated directly into the recommendations. Finally, we suggested some recommendations, with a view to provide practical guidelines for the design and implementation of effective innovation programs.

Lastly, the limitations of this end-of-study work are set out, as are the prospects for further works that could be explored more deeply.

## Chapter 2

### Literature review

The literature review first analyzes the ontological aspect of innovation education, defining not only innovation but also innovation education and highlighting its intersection with entrepreneurship. We then turn to the educational aspect, analyzing the literature on the following five dimensions: Why? For whom? For which results? What? How? This literature review provides a theoretical basis for the inventory that follows this section.

#### 2.1 Ontological level of teaching model for innovation education

This first part represents the ontological level of our teaching model for innovation education. This level includes the explicit definition of innovation as a field of education and the definition of education in the context of innovation (Fayolle & Gailly, 2008).

Innovation can be defined in several ways; this is illustrated by Baregheh *et al.* (2009). They identified around sixty different definitions of innovation based on the different disciplinary literatures. From Varadarajan (2018), the definition of innovation is the creation of value by using relevant knowledge and resources for conversion of an idea into a new product, process, or practice, or improvements in an existing product, process, or practice. Gailly (2018) defines innovation as a combination of newness and change. Where newness refers to the degree of which something is perceived as different from what existed before. Innovation has a major importance in our contemporary society since it is a driver of economic growth, societal development, and technological advancement. He also highlights that global and industry trends require businesses to make decisions about new and existing innovations on a continual basis. Every company needs to include innovation on its strategic agenda because handling innovation has become essential (Gailly, 2018).

To address what already exists in the literature on innovation education, it is important to mention the intersectionality of innovation and entrepreneurship education. Indeed, entrepreneurship and innovation are often linked together when studying these field in the context of education or training. While innovation and entrepreneurship have some synergies, they still are different concept with different knowledge (Maritz & Donovan, 2015). McFadzean *et al.* (2005) propose a combined definition of the corporate entrepreneur and the innovation process. This illustrates how much the synergy between these two concepts is high.

Fayolle (2010) defines entrepreneurship education as pedagogical programs or education that aims to develop entrepreneurial attitudes, skills and personal qualities, which are designed to empower individuals with the necessary tools to initiate a new business. This field is quite well covered in the literature. Schmitz *et al.* (2016) explain that terms related to academic entrepreneurship are discussed more often than the terms related academic innovation. Only two models are linked to university innovation, while for university entrepreneurship or the entrepreneurial university, there are seven models. Three other models are available to classify universities according to entrepreneurial aspects. Moreover, Fayolle and Gailly (2008) propose a conceptual framework in entrepreneurship education but none for innovation education. Chandra *et al.* (2020) highlight that while the idea of innovation has been around for a while, innovation education is a relatively new field. Lewrick *et al.* (2010) propose a definition of innovation education programs as pedagogical programs or education for innovation capabilities and skills, which involve personal, technical and organizational qualities. These programs are designed to empower individuals with the necessary tools to undertake innovative initiatives and implement these within an organization. Maritz & Donovan (2015) highlights the fact that while both disciplines have many similarities, they also have unique characteristics related to training and education. Both innovation and entrepreneurship are present throughout the process, but the focus is on innovation (more related to the creation of novelty) at the beginning of the process and on entrepreneurship (more related to the creation of value) at the end of the process (Schmitz *et al.*, 2016a).

We can summarize that there are various definitions of innovation existing in the context of innovation education programs. This is mainly due to the high number of actors present in the field of innovation. Indeed, Schmitz *et al.* (2016c) highlight the importance of the triple helix which refers to the interweaving of university, industry and government in a model of spiraling links to advance economic and social development through innovation strategy. Fayolle and Gailly (2008) propose that each entrepreneurship program should be based on a clear conception of entrepreneurship which should led to an explicit definition of entrepreneurship education. We can make the same proposition for innovation education. This is supported by Belkhir *et al.* (2018) when they argue that it is challenging to understand the discipline's fundamental framework when there is no agreed-upon definition, which makes developing a successful teaching program even more difficult. Moreover, Chandra *et al.* (2020) add that it is difficult to develop an unanimously acceptable framework since the field of

innovation shares a lot of terms with other domains. As a result, this area has inconsistent borders.

As regards the definition of education in the context of innovation education, we can make a link with entrepreneurship. As Fayolle and Gailly (2018) highlight for the entrepreneurship sector, the term “educate” is more appropriate than the term “teach” when we abord the domain of innovation education. Teaching involves a degree of passivity of the learner, while for innovation education, the goal is to foster active commitment and the development of critical thinking skills (Seidel *et al.*, 2020). Fayolle and Gailly's (2018) focus on using the term “educate” instead of “teach” highlights how crucial it is to foster a well-rounded approach to learning. In innovation education, educators serve as mentors and facilitators, helping students navigate their learning path, rather than just being providers of information. Nevertheless, in the remainder of this thesis, we will also use the term “teach” interchangeably with “educate” to avoid redundancy.

## 2.2 Educational level of teaching model for innovation education

Fayolle and Gailly (2008) analyze the educational level of a teaching model for entrepreneurship education. They used five specific interrelated questions; these questions must be answered in a specific order:

1. Why? This question asks the objectives and goals of the program.
2. For whom? Who are the targets or the audiences of the program?
3. For which results? What are the evaluations or the assessments?
4. What? What content or theories are related to this program?
5. How? What methods or pedagogies are used?

We will analyze the educational level of a teaching model for innovation program using these five dimensions.

### 2.2.1 Why?

Some of the objectives of innovation education have already been mentioned above. But we can add that innovation is a determinant of growth and economic productivity (Broughel and Thierer, 2019). Moreover, Chandra *et al.* (2020) highlight the importance of innovation for having the capacity to survive and thrive in a rapidly changing world. Indeed, there is an economic goal for innovation programs. Organizations can keep up with the competitive markets thanks to innovations. The cases of Kodak and Nokia are a good illustration of the

importance of being able to adapt to external circumstances and change in response to the needs and expectations of the customer (Chandra *et al.*, 2020). Kodak invented and patented the digital camera technology but was disrupted by the resulting innovations (Gailly, 2018). In the early 2000s, Nokia was one of the world leaders in the cell phone sector but failed to adapt quickly to changes in key industry success factors. With the introduction of the Internet and the widespread use of smartphones, Nokia was unable to remain competitive in the market (Chandra *et al.*, 2020).

Moreover, innovation programs have also a pedagogical goal since organizations, which are operating in highly competitive environment, need people who can work in interdisciplinary settings and are able to think outside-the-box. Gailly (2018) highlights the fact that it is impossible to think completely outside the box, but the challenge is to be aware of existing "blindness" and to be able to remove them. In this aim innovation education should develop different skills to form the best innovation managers. Innovation programs can help to become the "right person". Gailly (2018) gives us an idea of what are the right people: they must combine the right personality, abilities, expertise and backgrounds having enough creative thinking and interpersonal skills, in particular sociability. These educational programs can propose different disciplines to create and develop an understanding of the different theories of innovation, to foster critical thinking and problem-solving skills and encourage collaborative learning and teamwork.

Finally, innovation program could have a social goal by promoting sustainable innovation projects, establishing community partnerships (collaborating on sustainable innovation initiatives with a direct social impact together with governmental, non-governmental, and local communities) and encouraging an ethical mindset in innovation (Maritz *et al.*, 2014).

We can conclude this section with the similar proposition of Fayolle and Gailly (2008) which is that innovation course should target precise and complete objectives both at the macro and micro level.

### 2.2.2 For whom?

Fayolle and Gailly (2008) highlight that entrepreneurship course should be designed through a thorough understanding of the profile and background of the audience. Maritz *et al.* (2014) obtain the same conclusion for the innovation programs case. Indeed, teaching innovation must be adapted to face the diverse and varied audience. Maritz *et al.* (2014) highlight the different

types of targets that exist such as students (post-graduated or not), governments, academic, entrepreneurs, professionals across various industries, etc. Through adaptation of the educational approach, the innovation program may guarantee that its material is not only educational but also fosters a more engaging and impactful learning experience. For example, students can benefit from the program's offerings to enhance their studies and career prospects. The program could encourage collaborative projects and critical thinking to apply in real life what they learn in theory. In conclusion, to maximize its reach and impact, an innovation education program should have a strong emphasis on inclusivity and diversity. It is intended for a broad range of audiences, including academics, innovation management professionals, and students (Maritz *et al.*, 2014).

### 2.2.3 For which results?

This section reviews the literature on the outcomes and assessment of these programs. There are two types of evaluation for this program. There is the program evaluation itself, which assesses the program's measurability, and the learner evaluation, which includes skills and understanding of the subject (Maritz *et al.*, 2014). Moreover, evaluations within these programs should include both the process and the outcomes. Chandra *et al.* (2020) highlight that assessment of innovation education programs lacks information in the literature. The lack of methods for measuring effectiveness is currently one of the biggest gaps in this field. Pre- and post-surveys are a major tool used in studies to track changes in participant attributes, including knowledge and self-efficiency. The result of an innovation education program is an improvement in the participant's ability to innovate. These results take almost always time to materialize, making it difficult to measure the impact of an innovation education program. Furthermore, according to Chandra *et al.* (2020), two aspects need to be considered when evaluating a program: the short term and the long term. Short-term evaluation is simpler and takes the form of an ex-post study. It becomes more complicated when it comes to assessing long-term results.

### 2.2.4 What?

This section reviews the content of innovation education programs. While Fayolle and Gailly (2018) propose three dimensions for the content dimension of entrepreneurship education programs, which are the professional dimension, the spiritual dimension and the theoretical dimension, Maritz *et al.* (2014) highlight that there are various approaches to the content of innovation education programs. We can agree with Fayolle and Gailly (2018) and say that the

objectives and expected results significantly influence the structure and content of these programs. Maritz *et al.* (2014) propose different sub-sections for the question “what?”.

The first component of the content section is innovation management and process. Tidd and Bessant (2009) explain that this field focuses on the strategies, practices and decision-making processes that help individuals and organizations to generate new ideas and to transform them into practical, competitive products or services. It encompasses the entire innovation lifecycle, from ideation to implementation. Integrating this field into innovation education programs enables learners to acquire the managerial knowledge needed to supervise innovation projects, ensuring that they are in line with the organization’s objectives and the needs of the market (Maritz *et al.*, 2014).

The second component is resource planning which is linked to the efficient allocation of resources, including time, money and human capital (Gupta, 2023). Teaching resources planning prepares learners to assess the resources needs of innovation projects, to plan and optimize the use of available resources to achieve the desired results (Maritz *et al.*, 2014).

The third part is theory-based, practice-based, evidence-based and outcomes-based content which introduces the fundamental principles of innovation, enables learners to apply these principles in the real world, encourages the use of data and research to inform innovation decisions, and ensures that learning processes are designed to achieve specific results.

The last components are the entrepreneurship process, design management and technology management (Maritz *et al.*, 2014).

Finally, the content of innovation education programs can also vary according to the different types of innovation addressed. According to Lewrick *et al.* (2010) the different typologies of innovation should be discussed in class. They add that the program should focus on identifying the most relevant type of innovation at each stage of a company's life cycle. Gailly (2018) proposes seven types of innovation that are more strategic or operational.



Figure 1: Innovation typology by Gailly (2018)

For example, programs for early-stage companies may benefit more from product innovation to build market presence, while programs for more mature companies may focus on process innovation.

### 2.2.5 How?

Fayolle and Gailly (2008) emphasize that pedagogy is not an end, but a means to an end. There are a wide variety of ways of educating people about innovation (Maritz *et al.*, 2014). The pedagogy should be chosen in term of maximizing the chance to achieve the final objective set out in question what. In this wide varieties of ways to educate, we can find, according to Maritz *et al.* (2014), assigned readings, lectures, case studies, exams, individual or group works. These ways of teaching are traditional pedagogies. Nowadays, we are more and more talking about innovation pedagogy, which fills the gap between theoretical knowledge and practical working life requirements. Indeed, this method is based on several key ideas, such as a focus on working life and teamwork, entrepreneurship, global thinking, systems understanding and inclusivity. These factors help to make learning more innovative with the aim of improving both specific

skills in a field and general skills in the creation of new ideas. This includes the skills your own, the skills of relating to others and the skills of making connections (Konst and Kairisto-Mertanen,2020). In this last category we can find different ways of educating innovation: workshops and seminars, interviews with entrepreneurs, role playing, competitions, hackathons, guest speakers, knowledge creation, e-learning, simulation games (Maritz *et al.*, 2014).

Moreover, Seidel *et al.* (2020) examine the pedagogy involved in teaching innovation processes and classify approaches into four modes depending on the teaching method (experimental or analytical) and the participants' context (disciplinary or interdisciplinary). The first mode, called *emerging trends* focuses on conceptual analysis within a single discipline, typically using lectures, readings, and case studies to explore new technologies and theoretical frameworks. The second mode, called *new perspectives* combines conceptual and analytical methods with an interdisciplinary approach, drawing on expertise from several fields to provide a global understanding of innovation. Then there is the *focused inquiry* mode which focuses on experiential learning in a single discipline, engaging learners in hands-on projects, prototypes development, etc. The last mode is called *design thinking* and involves practical and experimental learning activities within an interdisciplinary team, often focusing on user-centred design processes.

Teaching method	Experiential/ Making	Focused Inquiry	Design thinking
	Conceptual/ Analysis	Emerging Trends	New Perspectives
		Disciplinary	Interdisciplinary
		Participant context	

Figure 2: Four Modes of Teaching Innovation by Seidel *et al.* (2020)

We can conclude with the same proposal made by Fayolle and Gailly (2018) concerning the entrepreneurship education program: the selection of pedagogical methods for each innovation

education course must be based on their a priori appropriateness and effectiveness in relation to the objectives, the characteristics of the audience, the content and the constraints due to the institutional context.

### 2.3 Conclusion

This literature review provides a theoretical basis for the inventory. As in the field of entrepreneurship, there is no educating model created directly for the field of innovation. For this reason, we have adopted the five-questions model used to carry out the same analysis of entrepreneurship made by Fayolle and Gailly in 2018. They followed a basic framework derived from the educational sciences proposed by Mialaret in 2005.

## Chapter 3

### Directory

This section of the thesis presents a mapping of innovation education programs, divided into theoretical and practical analyses. First, we explore the theoretical directory, using the theoretical models discussed in the literature review. Next, we carry out the empirical research, analyzing different programs to propose an inventory that highlights the major trends. Finally, the perspectives of two experts provide critical feedback on the directory.

#### 3.1 Theoretical directory

This first section concerns the design of the theoretical repertory which has two main dimensions: the audience and the objective. Considering the ontological and educational dimensions of innovation, we have used the previous teaching model as our theoretical framework to carry out the theoretical inventory. As far as the audience is concerned, we will focus on the three main groups proposed by Maritz *et al.* (2014): academics, professionals, and students. This section therefore takes up the “for whom?” part of our teaching model.

We have already seen that the objectives of innovation are many and varied. For this reason, we have decided to classify them into three broad categories: understanding innovation, developing disciplinary competencies and developing transverse competencies. These last two objectives are proposed by Miranda *et al.* (2021) and cited in Akimov *et al.* (2023). They define transversal skills as critical thinking, cooperation, collaboration, communication and creativity.

Disciplinary skills, on the other hand, are defined by the training and development of functional and technical knowledge and skills; the development of research and design skills through the creation and implementation of new technologies; and the use of the latest technologies and best practices in technological solutions. This dimension answers the “why?” question from our teaching model for our inventory. For each combination, we suggest one mode of teaching from Seidel *et al.* (2020) mentioned above and the different pedagogies from Maritz *et al.* (2014) related to this mode. This allows us to include the “how?” question in our inventory. We have linked the various modes to objectives and audiences using the characteristics of the modes proposed by Seidel *et al.* (2020).

<b>Audience/Objective</b>	<b>Understanding innovation</b>	<b>Developing disciplinary competencies</b>	<b>Developing transverse competencies</b>
<b>Students</b>	Emerging Trends (analytical-disciplinary) Lectures, readings, case studies, guest speakers	Focused Inquiry (experimental-disciplinary) Individual or group work, hands-on projects, simulation games	Design Thinking (experimental-interdisciplinary) Workshops, hands-on projects, hackathons, role playing
<b>Professionals</b>	Emerging Trends (analytical-disciplinary) Lectures, readings, case studies, guest speakers	Focused Inquiry (experimental-disciplinary) Workshops and seminars, hands-on projects	Design Thinking (experimental-interdisciplinary) Workshops and seminars, collaborative projects
<b>Academics</b>	New Perspectives (analytical-interdisciplinary) Lectures, readings, and seminars	Focused Inquiry (experimental-disciplinary) Individual or group work, research projects, writing	Design Thinking (experimental-interdisciplinary) Workshops and seminars, case studies

Table 1: Matrix based on the Four modes from Seidel *et al.* (2020)

When the goal is to understand innovation, two modes are privileged: *emerging trends* and *new perspectives*. *Emerging trends* is one of the most suitable modes to understand innovation, as it allows students and companies to focus in depth on the conceptual analysis within their discipline (Seidel *et al.*, 2020). Through lectures, readings and case studies (Maritz *et al.*, 2014), students can gain a global understanding of new technologies and theoretical frameworks specific to their field of study. Professionals can stay informed and adapt their strategies to capitalize on emerging opportunities while analyzing case studies and industry-specific examples. Academics, on the other hand, benefit from an interdisciplinary approach to understand innovation as it provides them with diverse perspectives and viewpoints in multiple fields. Analyzing innovation trends and theoretical frameworks from an interdisciplinary perspective enables academics to gain a holistic understanding of innovation dynamics and encourages innovative research approaches (Seidel *et al.*, 2020).

The *focused inquiry* mode is best suited to achieve the objective of developing skills (Seidel *et al.*, 2020). Students benefit from practical projects focused on their discipline and the development of prototypes. By engaging in targeted research, students can gain valuable experiential learning opportunities to develop their skills effectively. Like students, academics can enhance their skills by conducting targeted investigations in their discipline. Participation in practical projects and prototypes development allows academics to deepen their expertise and develop innovative research methodologies that contribute to the advancement of knowledge in their field (Pedaste *et al.*, 2015). Professionals can benefit from the practical, disciplinary approach of *focused inquiry* mode to develop their innovation skills. Participating in workshops and activities fosters creativity, problem-solving and collaboration, which are essential for stimulating innovation within organizations and responding effectively to market demands (Panke, 2019).

Regarding the last objective, being able to manage innovation, the interdisciplinary and experimental mode, called design thinking by Seidel *et al.* (2020), is dominant. To prepare participants to manage innovation, it is essential to expose them to interdisciplinary collaboration and practical approaches to problem-solving. This mode, with its emphasis on user-centred design and interdisciplinary teamwork, equips students with the skills and mindset to effectively manage innovation projects in different fields (Panke, 2019).

### 3.2 Analysis of the programs

To compare our theoretical directory with existing programs, we used the saturation-type approach. Data saturation means that researchers no longer find additional data in the programs they find. In most cases, researchers try to find groups that maximize the diversity of data to ensure that saturation is based on the widest possible range of data on the category (Dovetail Editorial Team, 2023b). Researchers can achieve this by using purposive sampling techniques, in which they select participants based on specific characteristics that should yield a diverse range of viewpoints. They can also use convenience sampling, where units are selected for inclusion in the sample because they are the easiest for the researcher to access (Ncsc, 2022). These programs come either from the United States or Europe. For each program we analyzed which are the modes of learning (Seidel *et al.*, 2020) represented through the program. This analysis will help us to improve and complete our theoretical directory. It is important to mention that most programs contain a little of each mode proposed by Seidel *et al.* (2020). The aim of this analysis is to perceive which modes are most frequently used, depending on the type of program. To identify the best suited modes of the different programs, we have used six criteria. They take the form of yes/no questions (see D. Program sorting criteria., Appendices). Analysis of programs according to the five questions and links to brochures can be found in the appendices (see A, B, C., Appendices).

#### 3.2.1 Programs available for the student audience

For the student audience, there are many programs available. We analyzed nine programs, before reaching the saturation level discussed above. There are different types of programs with different lengths, some of them take place over a year and others over a few days.

<b>Program</b>	<b>Location</b>	<b>Duration</b>	<b>Price and format</b>
Major in Innovation Management	Louvain School of Management Louvain-la-Neuve (Belgium)	About 5 months	Not mentioned On campus
Advanced Master in Innovation & Strategic Management	Solvay Brussels School – Brussels (Belgium)	1 year	€ 18.500 On campus

Master in Innovation & Entrepreneurship	Vlerick Business School – Leuven (Belgium)	1 year	€ 19.800 On campus
Master in Entrepreneurship & Innovation	Hult international Business School – San Francisco (USA), London (UK), Dubai (UAE)	1 year	Around € 50.000 On campus
Accelerated Certificate Program Innovation Management and Entrepreneurship	University of California, Irvine (UCI) – USA	3 months	\$7,900 On campus
Challenge EDHEC open innovation	EDHEC Business School – France	2 days	Not mentioned
Classes d'innovation & The hackathon series; learning innovation by doing	Circle U European Universities Alliance & École Polytechnique de Louvain (Belgium)	2 days kick off session, followed by a 10-week project	Not mentioned On campus
Kick Start Student Innovation Programme	Student innovation hub, University of the West of Scotland – UK	In term of days	Not mentioned
Innovation & Entrepreneurship Program for US student (Summer school)	EIT Digital-Ljubljana (Slovenia)	12 days	€ 2.950 On campus

Table 2: Descriptive table of programs for students

The first program analyzed is the Major in Innovation Management proposed by the Louvain School of Management. For this program two of the four modes from Seidel *et al.* (2020) stand out relevant.

- *New perspectives* mode fits well because of the interdisciplinary and analytical approach, integrating various aspects of innovation management and targeting people with different background to have a broad understanding of innovation.

- The second mode is *design thinking* with an interdisciplinary and experimental approach since the program proposes practical application through case studies, group projects, this mode supports hands-on learning.

The second program we analyzed is the Advanced Master in innovation and strategic management proposed by Solvay. This program aligns well with two of the four modes.

- The first mode is *design thinking* because of its experimental and interdisciplinary approach. The pedagogy of this master includes real-life case studies, workshops, simulations.
- The second mode is *new perspectives* thanks to its blend of conceptual and analytical methods across all disciplines such as general management, entrepreneurship, reasoning and analytical skills, innovation and technology and personal career development.

The third program is a Master in innovation and entrepreneurship proposed by Vlerick Business School. This program aligns well with two of the four modes.

- The first mode is *design thinking* with an interdisciplinary and experimental approach. The program uses an experimental learning through action, where students engage in start-up accelerator projects, business simulations and actual consultancy assignments.
- The second mode highlighted is *new perspectives*. This master has a strong focus on analytical and interdisciplinary approach. The program integrates knowledge from different fields, including technology, business management, finance and marketing. Collaborative projects are also part of the program.

The next program is a Master in entrepreneurship and innovation by Hult International Business School. For this master two modes resonate well.

- The first mode is *new perspectives* with an interdisciplinary and analytical approach. It aims to give students a holistic understanding of entrepreneurship and innovation, integrating diverse perspectives to address real-world business challenges.
- The second mode is *design thinking* with an interdisciplinary and experimental approach. It emphasizes practical learning, real-world business challenges and interactive exercises, teamwork, collaboration and devises new business models.

The analysis of Accelerated Certificate Program Innovation Management and Entrepreneurship proposed by University of California, Irvine (UCI) emphasizes two most relevant modes.

- The first mode is *new perspectives* with an interdisciplinary and analytical approach. It aims to provide students with diverse perspectives on innovation by encouraging critical thinking and integrating knowledge from a range of disciplines.
- The *design thinking* mode with an interdisciplinary and experimental approach also fits to this program since it focuses on the practical application of design thinking methodologies to generate ideas, understand customers and manage creative teams. It emphasizes practical experiences and real-world applications.

The next program is a challenge proposed by the EDHEC Business School called the Open Innovation Challenge. This challenge fits well with one of the four modes.

- The interdisciplinary and experimental approach of *design thinking* is a key feature of this program. Students gain valuable hands-on experience in open innovation through active participation in practical exercises and prototyping. In addition, collaboration with partner companies and experts from different fields fosters interdisciplinary teamwork.

The next program is proposed by Circle U European Universities Alliance and Ecole Polytechnique de Louvain and is called Classes d'innovation and the hackathon series; learning innovation by doing. Two modes fit well for this program.

- The *design thinking* mode which is an interdisciplinary and experimental approach is well represented through this program. It focuses on learning by doing and participation in activities such as hackathons and rapid prototyping. By forming multidisciplinary teams and taking on real-world challenges proposed by professors and industrial partners, the program encourages interdisciplinary collaboration and learning.
- The second mode is *new perspectives* with an interdisciplinary and analytical approach. Two workshops focus on the theoretical aspects. The aim is to understand the problem and the concerned ecosystem and to have the theoretical basis to then move on to the practical level.

The Kick Start Student Innovation Program is proposed by the University of the West of Scotland and through its analyze we identified one mode which is most represented.

- The main mode is *design thinking* since it focuses on practical learning experiences in an interdisciplinary setting. The program encourages students to develop their creativity and innovative ideas through workshops, competitions and acceleration programs. It involves collaboration with mentors and industry experts to develop business plans reflecting the experimental aspect of the program in an interdisciplinary context.

The last program is proposed by eit Digital and is called innovation and entrepreneurship program for US students. Two modes are mainly represented through this program.

- The *design thinking* mode focuses on practical experiences in an interdisciplinary context. The program offers participants dynamic workshops, collaborative projects and hands-on experiences to explore digital innovation and entrepreneurship. It encourages participants to develop innovative solutions to real-world challenges using emerging digital technologies. This reflects the experimental aspect of the program in an interdisciplinary setting.
- The second mode is *new perspectives* with an interdisciplinary and experimental approach. Through expert lectures, the program develops an understanding of the theoretical aspects of innovation and entrepreneurship.

This analysis shows that the most common mode is "design thinking". Its presence suggests a focus on experimental approach and interdisciplinary collaboration in innovation education.

The *focused inquiry* and *emerging trends* modes were not mentioned, that may be explained by the fact that many programs are interdisciplinary. The mode *focused inquiry* implies experimental learning in a single discipline, which may not correspond to the holistic approach often adopted in innovation and entrepreneurship education. We also note that the experimental aspect is more present than the analytical. This would mean that programs emphasize concrete problem-solving, collaborative projects and experiential learning rather than theoretical analysis.

Moreover, the modes outlined in the Seidel framework are not mutually exclusive. Programs combine different approaches to create a comprehensive learning experience that covers various aspects of innovation. A program can use the *design thinking* mode for hands-on, interdisciplinary projects, while also exploring the *new perspectives* mode to develop the understanding of fields related to innovation.

Similarly, program objectives can be multiple, complementary and divergent, depending on the learning mode. While the main objective may be to develop students' innovation skills, programs may also aim to foster critical thinking, teamwork, adaptability and leadership skills.

### *3.2.2 Programs available for the professional audience*

There are many programs available for the second audience, the professionals. We analyzed nine programs, before reaching the saturation level discussed above. There are also different types of programs with different durations.

<b>Program</b>	<b>Location</b>	<b>Duration</b>	<b>Price and format</b>
Gestion de l'innovation programme exécutif	University Catholic of Louvain -Belgium	13 days	Not mentioned On campus
Innovation: A Design Thinking Approach	Imperial College Business School London - UK	4 days	£4,350 On campus
Formations innovation et créativité	Cegos – France	2 days	€1,000– € 5,000 On campus or online
Design Thinking for Strategic Innovation	Trinity College Dublin- Ireland	5 days	€950 Online
Learn & Drive Strategic Innovation with Design Thinking Course	Stanford University – USA	14weeks (7-8 hours weekly commitment)	\$4,000 On campus and online
Managing Innovation Strategically	University of Cambridge - UK	2 days	£2,990 On campus or online
Innovation and Strategy	Harvard Division of Continuing Education - USA	4 days	\$2,990 - \$2,750 On campus or online
Design Sprint Hackathon	Design Sprint Academy- Berlin, Germany	About 3 weeks	Not mentioned

Workshops innovation: explorez, innovez et construisez	La Guilde de l'Innovation - France	Not mentioned	Not mentioned
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Table 3: Descriptive table of programs for professionals

The first program for this audience is called 'Gestion de l'Innovation Programme Exécutif' and is proposed by Université Catholique de Louvain. This program, also called LOUVINNO, takes place over 13 days. Two of the Seidel's modes are well represented through this program.

- The first mode highlighted by the LOUVINNO program is *design thinking*. It emphasizes the practical application and active learning in an interdisciplinary context. The structure of the program, which includes case studies, testimonials and work on a company project, is a key feature of the teaching method.
- The second mode we found relevant is the *new perspectives* mode which is an interdisciplinary and analytical approach. The program includes theoretical sessions to acquire the concepts and theories they need to apply in the experimental mode.

The second program is available at the Imperial College Business School and is called 'Innovation: A Design Thinking Approach'. This program is given over four days. Our analysis has enabled us to identify a mode that is well exploited during these four days.

- The program emphasizes a hands-on learning approach through workshops, real-case, networking that align with the experimental aspect of *design thinking*. In addition, the program welcomes participants from a variety of sectors and nationalities which reflects the interdisciplinary approach.

The third program are trainings on innovation and creativity proposed by the company Cegos. These trainings are taking place during approximately two days. Two modes predominate in these trainings.

- The *focused inquiry* mode involves experimental approach within a specific discipline. Cegos training emphasizes a practical, interactive approach, including self-diagnosis, group work and real-life implementation sessions. These training courses are booked by a company or manager to work with their teams in the same discipline.

- The second mode is *emerging trends*. These training courses also have a conceptual mode through the theories on used models, this method is still within the disciplinary framework here.

The next program is from the Trinity College Dublin and is called Design Thinking for Strategic Innovation. The program consists of five days over a five-week period. Two of the four modes presented by Seidel *et al.* (2020) are well illustrated in this online program.

- The first mode is *new perspectives* with an interdisciplinary and analytical approach. The program covers many theoretical concepts and is suitable for different types of professionals whose responsibilities may include business development, customer experience, marketing, operations and employee engagement.
- The second mode is *design thinking*, which is an interdisciplinary and experimental approach. The program aims to equip participants with the practical skills needed to positively influence their working environment.

The next course is proposed by the Stanford University and is called Learn and Drive Strategic Innovation with Design Thinking. This fourteen-weeks online course represents one of the four modes.

- The course closely follows the structure of *design thinking* which is an interdisciplinary and experimental approach. By encouraging participants to engage in hands-on activities such as observation, interviewing, brainstorming, prototyping and testing, the program brings together professionals with diverse backgrounds, including product managers, designers, marketers and entrepreneurs. This program fosters interdisciplinary collaboration and the exchange of ideas.

The next program, Managing Innovation Strategically, is taking place during two days in the University of Cambridge. One of the four mode stand out from our analysis.

- The mode is *new perspectives* with an interdisciplinary and analytical approach. The program encourages collaboration with leading members of the University of Cambridge in different fields and covers a wide range of topics. This interdisciplinary approach enables participants to gain an understanding of innovation management, drawing on multiple disciplines to effectively address complex challenges.

Harvard Division of Continuing Education offers the Innovation and Strategy Program which is taking place for four days. This program highlights two of the four modes proposed by Seidel *et al.* (2020).

- The *design thinking* mode seems to be best match for this program. Indeed, it offers a practical approach, incorporating interactive group exercises, real-world examples and case discussions to facilitate learning. Participants take part in practical frameworks and methodologies such as design thinking and lean-startup frameworks. In addition, the program covers a wide range of topics related to innovation and strategy. The program also appeals to people from diverse backgrounds and industries.
- The second mode is *new perspectives* with an interdisciplinary and analytical approach. On the first day, the program covers theory relating to the practical frameworks used, as the four types of innovation, the five skills of disruptive innovators, design thinking and the lean startup framework.

The following program is offered by the Design Sprint Academy. They organize various activities, including the Design Sprint Hackathon. This hackathon is taking place for 48 hours and is clearly highlighting one of the four modes of Seidel.

- The main mode fitted for this event is *design thinking* which is an interdisciplinary and experimental approach. Indeed, the program encourages rapid ideation and prototyping during the hackathon, suggesting an experimental approach to problem solving. The program also brings together diverse teams from organizations, including senior executives, subject matter experts and change agents. These teams are likely to have varied backgrounds and expertise, fostering an interdisciplinary environment where different perspectives contribute to problem-solving.

The last program is called Workshops innovation: explorez, innovez et construisez and is given by La Guilde de l'Innovation. These workshops highlight two modes which are:

- The first mode is *focused enquiry* which is a disciplinary and experimental approach. The program fosters team collaboration ensuring that participants work together in the same discipline or field and engage in iterative processes of ideation and prototyping fostering an experimental mindset. Solutions are customized and refined based on real-time feedback fostering an experimental approach to problem-solving.
- The second mode is *emerging trends* which is a disciplinary and analytical approach. These training courses also have a conceptual mode through the theories on models used

such as design thinking theories. This method is still within the disciplinary framework here.

This analysis allows us to note several modifications to be made to our inventory. First, we have mentioned that the experimental approach is dominant over the analytical approach. This means that when it comes to professionals, the practical aspect is more important. The focus is on developing skills and being able to manage innovation.

We also found that the experimental and interdisciplinary mode is the most widely used when it comes to professionals. Nevertheless, a nuance needs to be made we have found that when it comes to team programs, the *focused inquiry* mode is often used. The aim is to stay within the same discipline. On the other hand, when programs are open to several professionals from different companies, an interdisciplinary approach is adopted. We therefore propose to separate the professional section into two parts: the professional as an individual and the professionals who come as a team.

Our final observation concerns the objectives, that are often linked and lack sometimes of precision. In the next inventory, we will be proposing new and more appropriate objectives.

### 3.2.3 Programs available for the academic audience

For the last audience, academics, we found that they are less programs available. We analyzed five programs before reaching the saturation level discussed above. Most of these programs are PhD degrees.

<b>Program</b>	<b>Location</b>	<b>Duration</b>	<b>Price and format</b>
European Research and Innovation (R&I) Days	European Commission- Brussels, Belgium	2 days	Not mentioned Hybrid Event: Brussel and online
Innovation and Public Policy PhD	University College London- UK	4 years	£6,035 per year for home students £28,100 per year for international students On campus

Technology and Innovation Management Integrated PhD	University of Sussex - UK	5 years	£4,786 per year for home students £21,500 per year for international students On campus
Entrepreneurship and Innovation, Ph.D	Luleå University of Technology - Luleå , Sweden	4 years	Not mentioned
Management - Strategy and Innovation	Georgia Institute of Technology	5 years	Free

Table 4: Descriptive table of programs for academics

The first event we analyzed is the European Research and Innovation (R&I) Days proposed by the European Commission. This event takes place for two days in Brussels and we found one mode related to this event.

- The *new perspectives* mode can be associated with R&I Days as this event has an interdisciplinary and analytical approach. Indeed, participants play a crucial role in evaluating past achievements and planning future actions. This process involves in-depth understanding and critical analysis of data and trends, which are essential for formulating strategic ideas and making decisions on EU policies. In addition, the event includes a diverse mix of stakeholders with different professional and academic backgrounds. That enriches the discussions with their different perspectives.

The second program is proposed by the University College London and is called Innovation and Public Policy PhD. This program takes place for four years and is best described by two modes of Seidel *et al.* (2020).

- The first mode is *new perspectives* with an interdisciplinary and analytical approach. Participants develop their understanding of innovation through a series of courses on research methods and regular doctoral seminars. This aspect is part of the analytical approach. The interdisciplinary approach is justified by the fact that the program integrates multiple disciplines such as economics, philosophy, political science, design, anthropology and natural sciences to rethink economics and economic policy.
- The second mode is *focused inquiry* with a disciplinary and experimental approach. The program offers to conduct independent research over several years with structured

reviews and evaluations of progress made. For this research, the doctoral student specializes in one discipline.

The third program is a PhD in Technology and Innovation Management Integrated PhD offered by the University of Sussex. Two of Seidel's modes fit well with this five-years program.

- The mode is *new perspectives* with an interdisciplinary and analytical approach. The program integrates knowledge and methodologies from a variety of disciplines to address key issues in technological change and innovation management.
- The second mode is *focused inquiry* with a disciplinary and experimental approach. The program is dedicated to training in empirical research in which participants actively participate in the design and execution of experiments or studies. The research thesis requires experimental or empirical work that makes a significant contribution to the field of technology and innovation management. The dissertation process is disciplinary, focusing deeply on specific research questions and using detailed methodologies to explore these questions.

The next program is a Ph.D in Entrepreneurship and Innovation proposed by the Luleå University of Technology in Sweden. During these four years, the participants face two modes of teaching.

- The first mode is *new perspectives* with an interdisciplinary and analytical approach. The program aims to advance the field of entrepreneurship and innovation through the development of new theoretical and practical knowledge. This aspect is linked to the analytical and interdisciplinary approaches of this mode.
- The second mode is *focused inquiry* with a disciplinary and experimental approach. The program offers practical application through collaborative research projects with industrial partners and involvement in departmental tasks, including teaching. These activities remain rooted in a specific disciplinary field.

The last program we analyzed is offered by the Georgia Institute of Technology and is a PhD in Management: Strategy and Innovation. Two modes are more related to this program than the others.

- The first mode is *new perspectives* with an interdisciplinary and analytical approach. The program involves rigorous analysis of theoretical frameworks, empirical data and

research methodologies to generate meaningful insights into the interactions between strategy, innovation and business performance.

- The second mode is *design thinking* with an interdisciplinary and experimental approach. The program offers an experimental approach through teaching and practical projects in different field.

Thanks to this analysis, we can see that the two main modes are *new perspectives* and *focused inquiry*. This means that, in terms of analytical approach, most programs propose an interdisciplinary approach to gain a broad understanding of innovation through a variety of disciplines. When it comes to the experimental approach, participants focus on a single discipline, either in their teaching or in their publications. However, we note an exception in the last program analyzed, which proposes a practical, interdisciplinary approach.

For this audience, we found that the objectives did not coincide with the program objectives identified in the analysis of the five questions (see C. Academics programs details based on the brochure or the website, Appendices). We will therefore be proposing objectives adapted to each audience in our next inventory.

### 3.3 Final directory

Following our analysis, we decided to propose a different form for our directory. Indeed, the first variable remains the audience, which is now divided into four actors instead of three (students, professional as an individual, professional as a team, academics). For each section, we include the different learning modes proposed by Seidel et al. (2020) related to the audience. For each mode we propose a global objective, the different formats available, several programs corresponding to this section and the content of the programs. Finally, we will also indicate a scale for the average program duration. This information comes from the analysis of the programs based on the five questions addressed in the literature review (see A, B, C., Appendices). This type of inventory gives us a more precise and detailed classification. It is also important to remember that most of the time, the programs are based on a combination of the learning modes identified in this analysis.

<b>Student</b> (9 programs identified)	<b>Professional (as an individual)</b> (7 programs identified)	<b>Professional (as a team)</b> (2 programs identified)	<b>Academic</b> (5 programs identified)
<p><b>Mode of learning:</b> New Perspectives (Analytical - Interdisciplinary)</p> <p><b>Goal:</b> to develop a broad understanding of the theoretical frameworks of innovation and related fields</p> <p><b>Format:</b> assigned readings, workshops, seminars, group works</p> <p><b>Programs:</b> 7/9, for example, the Advanced Master in innovation and strategic management (Solvay)</p> <p><b>Content:</b> it varies and covers a wide range of innovation typologies and subjects</p> <p><b>Duration:</b> mostly a school year</p>	<p><b>Mode of learning:</b> New Perspectives (Analytical - Interdisciplinary)</p> <p><b>Goal:</b> to understand frameworks needed to drive innovation within their organizations</p> <p><b>Format:</b> theoretical sessions, testimonials, peer-to-peer learning, case studies</p> <p><b>Programs:</b> 4/7, for example the Managing Innovation Strategically Program (University of Cambridge) is designed for executives and managers to generate greater levels of innovation in their organization</p> <p><b>Content:</b> it can focus on a specific aspect or typology of innovation or cover several modules</p> <p><b>Duration:</b> in terms of days, between 2 and 14 days, either all at once or spread over several weeks</p>	<p><b>Mode of learning:</b> Emerging Trends (Analytical - Disciplinary)</p> <p><b>Goal:</b> to develop a deep understanding of theoretical frameworks within a specific discipline of innovation</p> <p><b>Format:</b> workshops</p> <p><b>Programs:</b> 2/2, two programs are found in this category, for example the Trainings Innovation and Creativity (Cegos) and the Innovation Workshops (La Guilde de l'innovation)</p> <p><b>Content:</b> it often focuses on a single aspect or typology of innovation</p> <p><b>Duration:</b> a couple of days</p>	<p><b>Mode of learning:</b> New Perspectives (Analytical - Interdisciplinary)</p> <p><b>Goal:</b> to provide foundation for further research innovation and to prepare the participants for their future career</p> <p><b>Format:</b> theoretical and methodological courses, intensive reading, discussion, seminars, critical analysis of key theories</p> <p><b>Programs:</b> 5/5, the program can be of different types such as the European Research and Innovation Days or the MPhil in Innovation, Strategy and Organization (University of Cambridge)</p> <p><b>Content:</b> a variety of innovation topics and typologies are covered</p> <p><b>Duration:</b> between three and five years</p>

<p><b>Mode of learning:</b> Design Thinking (Experimental - Interdisciplinary)</p> <p><b>Goal:</b> to develop the skills and knowledge needed to effectively manage organizations characterized by a dynamic environment</p> <p><b>Format:</b> workshops, seminars, simulation games, case studies</p> <p><b>Programs:</b> 9/9, master's programs such as the Master in Entrepreneurship and Innovation (Hult) but also shorter programs such as the Open Innovation Challenge (EDHEC)</p> <p><b>Content:</b> it varies and covers a wide range of innovation typologies</p> <p><b>Duration:</b> mostly a school year</p>	<p><b>Mode of learning:</b> Design Thinking (Experimental - Interdisciplinary)</p> <p><b>Goal:</b> to be able to act as an innovation champion and to foster innovation culture within their organizations</p> <p><b>Format:</b> group works, hackathons, real-world cases, hands-on activities</p> <p><b>Programs:</b> 6/7, almost all programs in this audience coincide with this mode, for example the Design Sprint Hackathon or the "Gestion de l'innovation programme exécutif" by UCLouvain</p> <p><b>Content:</b> it can focus on a specific aspect or typology of innovation or cover several modules</p> <p><b>Duration:</b> in terms of days, between 2 and 14 days, either all at once or spread over several weeks.</p>	<p><b>Mode of learning:</b> Focused Inquiry (Experimental - Disciplinary)</p> <p><b>Goal:</b> to generate ideas and solutions to address specific challenges or opportunities and develop a creative mindset</p> <p><b>Format:</b> workshops, group works, e-learning, prototyping, real-life implementation sessions</p> <p><b>Programs:</b> 2/2, two programs are found in this category the trainings innovation and creativity (Cegos) and the innovation workshops (La Guilde de l'innovation)</p> <p><b>Content:</b> it often focuses on a single aspect or typology of innovation</p> <p><b>Duration:</b> a couple of days</p>	<p><b>Mode of learning:</b> Focused Inquiry (Experimental - Disciplinary)</p> <p><b>Goal:</b> contribute to the advancement of knowledge and theory in the field of innovation and train the participants</p> <p><b>Format:</b> publications of research and teaching in a specific field</p> <p><b>Programs:</b> 3/5, some programs offer this experimental disciplinary approach, such as the Ph.D in Entrepreneurship and Innovation offered by Luleå University of Technology in Sweden.</p> <p><b>Content:</b> focuses on a specific typology or subject</p> <p><b>Duration:</b> between three and five years</p>
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/	/	/	<p><b>Mode of learning:</b> Design Thinking (Experimental - Interdisciplinary)</p> <p><b>Goal:</b> to foster interdisciplinary collaboration to meet societal challenges and to stimulate innovation</p> <p><b>Format:</b> publications of research in various field, hands-on project, teaching</p> <p><b>Programs:</b> 1/5, the only program to feature this learning mode is PhD in Management: Strategy and Innovation proposed by the Georgia Institute of Technology</p> <p><b>Content:</b> a variety of innovation topics and typologies are covered</p> <p><b>Duration:</b> between three and five years</p>
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Table 5: Final inventory

### 3.4 Two experts' perspectives on the directory

During our interviews with Julie Hermans and Françoise De Viron, we discussed several aspects of this directory.

First, it is important to make a point about the learning aspect. In fact, according to Ms. Hermans, the aim of training in innovation and entrepreneurship is really to provide players with the conceptual tools they need to make informed decisions and act with full knowledge of the facts. This involves a constant back-and-forth between the analytical and the experimental aspect because it is essential to ask ourselves the right questions about what we are doing, with whom and why. Françoise de Viron confirms this aspect and adds the notion of learning input. Indeed, learning consists of a change in habits, thoughts or behaviors initiated either by the individual himself or by his environment. It is therefore essential for program designers or teachers to be modest because training involves working with humans. The program does not offer learning, but rather learning opportunities.

The aspect of interdisciplinarity, used in our analysis, has also been addressed for clarification. Julie Hermans suggests that the disciplinary or interdisciplinary dimension brings a certain complexity in management science. In innovation, the interdisciplinarity can take different forms, depending on one's perspective. For some audiences, notably organizations and their employees, the interest lies in the ability to bring together people from different professions, rather than from distinct scientific disciplines. Innovation is, by nature, integrative and requires close collaboration between diverse professions. For her, innovation education must necessarily be interdisciplinary, but must always start from the point of view of the researcher's or teacher's discipline. Françoise de Viron confirms this aspect, adding that interdisciplinarity can be found both in terms of audience and content. It is important to justify whether we are talking about one or both. Moreover, the distinction between multidisciplinary and interdisciplinary is important. Multidisciplinary means that different disciplines are mobilized but that there is no intersection between them. Interdisciplinarity, on the other hand, implies genuine integration. This integration aspect is essential for a good innovation program.

In discussing the first audience and the associated learning styles, two very important aspects emerged from the two interviews: the articulation and the transfer of the conceptual and the experimental. Julie Hermans noted that it was essential to articulate moments of practice to

captivate students' interest and to generate curiosity with more theoretical moments. If we take the example of gamification, when students play, they often realize that they know less than they thought, which generates confusion. They have therefore linked these moments of play with more theoretical activities such as lectures to establish concepts and to encourage analytical thinking. She emphasizes the importance of combining the different learning modes discussed in the previous inventory. According to Julie Hermans, there are two types of participants. On one hand, there are the actors of innovation, those who are in the field and act to identify and implement opportunities.

On the other hand, there are the observers of innovation, such as students destined to work in consultancies, banks or the public service, who need to understand the theoretical aspects of the phenomenon. The need for articulation is likely to be greater for players than for observers. Actors need to be well equipped both practically and theoretically to succeed in a changing environment, while observers especially need to be equipped on the analytical aspects to be good observers. It's important to articulate both aspects, while giving a stronger meaning to one or the other depending on the program's audience.

Françoise de Viron add that we must be careful when discussing the distinction between the experimental and conceptual approaches. In fact, the two approaches feed off each other. To conduct a rigorous, scientific experiment, an expert need to engage in an in-depth analytical reflection. This is where the notion of transfer comes in. De Viron (2021) details the aspects of this transfer that are so important in an innovation program. First, there is the theoretical dimension, which can be compared to the conceptual dimension discussed in this thesis. This theoretical dimension includes the following three notions of transfer.

- To transfer is to build something new from the known: by perceiving a certain similarity between the learning and the application and using your own knowledge to build new ones (Frenay, 2004 as cited in De Viron ,2021).
- To transfer is to adapt by recontextualizing learning to a new situation (Roussel, 2011 as cited in De Viron ,2021).
- To transfer is to generalize by maintaining the acquired learning over time (Barth, 2004 as cited in De Viron ,2021).

The second dimension of transfer is the practical aspect of training which can be compared to the experimental aspect of this thesis. This section contains two notions of transfer.

- To transfer is to replicate, by finding a similarity between the training situation and the professional practice situation (Blume et al., 2009 as cited in De Viron ,2021).
- To transfer is to apply, to put into practice by concretely reusing what has been learned as cited in De Viron ,2021).

An analysis of these definitions shows that the notions of experimental and conceptual are difficult to separate. It is therefore essential to have both dimensions in a program for it to be complete.

When we broached the subject of the professional audience, the motivational aspect came up in both interviews. According to Julie Hermans, it is difficult to make a general trend for this audience because it is very variable. Whether the program focus on professionals as individuals or as a team, the mode will vary according to the specific needs of each organization. An important point is that there is often a big disparity between participants who have voluntarily chosen training and those who are forced into it by their employer. This has an impact on their commitment to learn. Françoise de Viron adds that when designing a program, it is crucial to consider participants' motivations.

Finally, for the last audience with the academics, Julie Hermans pointed out that there was only one interdisciplinary and experimental program. In fact, this program literally confirms the rule, and we can see that we are still very much in our own silos. When it comes to experimental work, we are clearly predominantly discipline based. When it comes to research, we expect the researcher to be over-specialized in one discipline, but it would be nice to have activities that allow to creation of an interdisciplinary approach.

The contribution of these interviews brings a critical and external point of view to our inventory, allowing it to be nuanced. The experience and knowledge of the interviewees offer a variety of perspectives that enrich the overall understanding of the subject. This allows us to validate or question certain aspects of the inventory, adding a dimension of empirical verification. For example, the back-and-forth between practical and theoretical aspects becomes crucial. In addition, these interviews reflect the importance of interdisciplinarity, not just multidisciplinary.

Finally, the additional recommendations provided by the interviewees are an added value. One crucial aspect highlighted is the transfer of knowledge and practices: it is essential to take this aspect into account in the final recommendations. In addition, interviewees' suggestions on program design highlight the importance of motivation, both for designers and end-users.

In short, the interview inputs provide a wealth of analysis that makes the inventory more complete, more nuanced, and better adapted to realities on the ground.

## Chapter 4

### Recommendations

This section integrates the results of the comprehensive inventory of innovation programs and the experts' advice to propose recommendations for program developers. Finally, we discuss limitations and further works, acknowledging the constraints of current research and suggesting directions for future studies.

#### 4.1 Recommendations based on the directory and the expert's perspectives.

The first point when developing an innovation program is to identify the audience we want to address. Format, content, duration all these vary according to the audience. The second point is to identify the objectives of the program we are developing. Once these two variables have been defined, it is time to choose the appropriate learning modes.

If the program is aimed at students, the designer could combine two modes of learning, *design thinking* (interdisciplinary – experimental) and *new perspectives* (interdisciplinary – analytical), while giving greater meaning to one or the other depending on the program's objectives. Julie Hermans suggests first making a clear distinction between actors and observers. This helps to manage expectations and ensure that each program meets the specific needs of its targeted audience.

On one hand, if the goal of the student is to be an observer and if the objective is to develop a broad understanding of the theoretical frameworks of innovation and related fields, the focus could be on an analytical and interdisciplinary approach. This mode emphasizes the importance

of fundamental knowledge in the form of readings, workshops, seminars and group work activities that foster critical thinking and in-depth understanding. This mode enables students to explore the links between innovation and other disciplines.

On the other hand, if the goal of the student is to be an actor and the aim is to develop the skills and knowledge needed to effectively manage organizations characterized by a dynamic environment, the focus of the program could be on experimental and interdisciplinary approach. This allows the participant to focus on developing the practical skills and knowledge needed to navigate dynamic organizational environments. For this type of mode, the formats available are workshops, seminars, simulation games and case studies that simulate real-world challenges. The best option based on this thesis for creating this program is a combination of two modes (*design thinking* and *new perspectives*), if the duration of the program allows. For example, if the program runs over a few days, such as a hackathon, it makes more sense to focus solely on the experimental and interdisciplinary mode.

The program designer could pay attention to the interdisciplinary aspect, which appears important following the interviews. The challenge lies in the ability to truly connect these different disciplines and foster a constructive dialogue, rather than simply juxtaposing them. Here, the program developer could truly seek interdisciplinarity, not multidisciplinary.

If the program is aimed at professionals, the designer could identify the category of professional involved and above all participants' motivations. The first sub-category is the professional who participates in the program as an individual. Here again, there is a combination of two learning modes, *design thinking* and *new perspectives*. The strong focus could be on interdisciplinary and experimental mode. This is an essential mode for this category of audience. The program could offer professionals the opportunity to participate in immersive learning experiences to allow them to act as innovation champions and to foster a culture of innovation within their organization. The program developer could use experiential learning methods such as group work, hackathons, real-life case studies and hands-on activities that foster creativity, collaboration and problem-solving. This mode could be combined with an analytical and interdisciplinary approach. The program designer can offer professionals theoretical frameworks to understand the theory linked to practice. To achieve this goal, various formats are available such as theoretical sessions, testimonials from industry experts, peer-to-peer learning opportunities and case studies that illustrate best practices in innovation management.

The second audience sub-category concerns professionals as a team. If the team members belong to the same department, then the trainer could combine analytical and experimental modes at disciplinary level. By using experiential learning, such as workshops, group work sessions and prototyping activities, the program allows the teams to generate ideas and solutions to meet the specific challenges or opportunities they face. In addition, the learners could have access to mentors, experts, and resources to support the process. The analytical mode provides an understanding of the models and frameworks used in practical learning.

Françoise de Viron insists on the importance of analyzing participants' motivations, regardless of their professional category. If the group is too large to analyze motivations individually, she recommends inviting participants to write them down. This will enable them to step back from the reasons why they enrolled in the program and see how far they have come by the end of the course. This exercise will make easier the exploitation of the various learning opportunities. Julie Hermans also adds that it would be appropriate to recommend that trainers ensure that there is a match between what they offer and the expectations of the organization. This check is most of the time possible as the content is co-created with the organization.

Finally, if the program is aimed at academics such as researchers, PhD students, etc. the developer could put a strong focus on an analytical and interdisciplinary approach. The developer could provide participants with a solid theoretical and methodological foundation for further research and work. To this end, it is important to offer courses that cover the main theories, methodologies and frameworks relevant to the field of innovation and related disciplines. The developer can use the following formats: lectures, seminars and critical analysis sessions, discussions and debates. In developing this program, interdisciplinary collaboration could be promoted to encourage a diversity of perspectives. This last mode is often combined with the experimental and disciplinary mode. The developer could offer active participation in departmental tasks including teaching and mentoring, to provide participants with valuable practical experiences and leadership opportunities. In addition, research projects will focus on a single discipline.

However, the use of experimental and interdisciplinary modes remains an exception. Julie Hermans adds that one of today's major challenges in terms of innovation, within a sobriety context, is to be able to identify innovations that are sustainable, that create adhesion even if

diminishing comfort. Developers could try to introduce this aspect of interdisciplinarity at the experimental level by offering experiential pedagogical approaches that combine theoretical concepts with hands-on projects in a variety of fields and by facilitating interdisciplinary collaboration through project-based learning experiences where participants work in multidisciplinary teams to solve complex problems.

#### 4.3 Limitations and further works

The first limitation is that it is possible that some innovation programs have not been considered: detailed information is sometimes difficult to find or brochures are not available at the time of our research. Despite our efforts to gather all the data, it is likely that some programs have not been considered, which could affect our conclusions.

Furthermore, our research is based primarily on the analysis of innovation program brochures. However, it is important to recognize that these brochures, while useful, have certain intrinsic limitations in terms of content and accuracy. Brochures are often designed to promote the program rather than provide a detailed or critical analysis of it. As a result, the information they contain can be selective, highlighting the most attractive or successful aspects of the program while downplaying or omitting its limitations.

The next limitation of this thesis concerns the alternative theoretical frameworks that have not been explored. It might have been interesting to carry out the program analysis using another theoretical framework such as the one proposed by Kolb. This model proposes a four-stage cycle that illustrates how learners create knowledge through interactions with the environment. Kolb's learning process cycle begins with a concrete experience (first step). The learner then steps back to reflect on the task. This second step is known as reflective observation. The third step in the learning cycle, known as the abstract conceptualization, is to make sense of these events. The final phase of the cycle is the testing phase, which is called active experimentation (D. A. Kolb, 1984). Kolb also highlights four types of individuals, each with their own preferences, which leads to the distinction of four main learning styles. Using this theoretical framework could have been interesting to bring a comparison to the framework we used in this thesis.

In addition, we may not have fully explored the interdisciplinary dimension of our work. By focusing on analyzing programs for different audiences, we may not have looked deeply enough at smaller units such as individual courses. However, this more detailed exploration at course level could have provided us with richer information on how different disciplines are integrated into innovation programs. This ties in with Julie Hermans' review when discussing about the interdisciplinary dimension.

For future works, it might be interesting to focus more on a specific audience or geographical region. Focusing on a defined target audience would enable a deeper understanding of the specific needs of these groups, and of the pedagogical approaches best suited to serve them. Restricting ourselves to a given geographic region would enable us to explore the cultural, socio-economic and political particularities that influence the design and the implementation of innovation programs in that area. This would lead to a better understanding of the unique challenges and opportunities facing program designers in that region and to more targeted recommendations. In addition, future work could focus on other geographical areas that may offer different programs.

Future works could enrich our analysis beyond the information available in the brochures by interviewing representatives of each innovation program. These interviews would provide more in-depth perspectives on the objectives, teaching methods, faced challenges and successes achieved by each program. It might also be interesting to gather testimonials from former participants to understand the real impact of the programs on their professional and personal careers.

In addition, future works could explore the use of another theoretical framework to enrich our analysis. This approach would provide a more complete understanding of how to adapt pedagogical methods to meet learners' needs and promote deeper learning.

Finally, the interdisciplinary aspect could be developed in future works by analyzing not only programs, but also by looking at smaller units such as individual courses. This approach would identify how different disciplines contribute to innovation education and how these perspectives interact to form a holistic approach to innovation education.

## Conclusion

This thesis explores the complex question of how can innovation be taught? First, we looked at the ontological aspect of innovation education programs. The literature review begins with the intricacies of innovation itself exposing a rich landscape of varied definitions and the significant overlap between entrepreneurship and innovation. This exploration established that innovation education programs are essential pedagogical initiatives designed to equip individuals with a comprehensive set of personal, technical and organizational skills. This thesis argues that the term “to educate” better captures the essence of innovation skills transmission than the traditional term “to teach”, reflecting a more holistic and integrative approach to learning in this field.

For the educational level, we analyzed the literature of innovation education programs through five critical questions: objectives (Why?), targeted audience (For whom?), expected results (For what results?), content and theories employed (What?), and methodologies and pedagogies applied (How?). This framework made possible to build a theoretical inventory on innovation education programs based on their audiences and objectives as discussed in the literature and it also took learning modes into consideration.

The empirical element of this thesis is an analysis of twenty-three innovation education programs, evaluated using the five-questions framework. This analysis concludes with a proposed final inventory of practices and methodologies being used in the field of innovation education. This inventory highlights major trends in innovation education. It is based on audiences and learning styles and suggests objectives, formats, content and durations. Finally, the interviews with two experts in the field of innovation education helped to refine the final recommendations thanks to their critical viewpoint.

In terms of recommendations, program developers could consider the following inputs when designing a program. Identifying the audience and the objectives is a key step enabling content and teaching methods to be tailored to the specific needs and objectives of participants. In addition, an innovation education program could incorporate a diverse mix of learning modes chosen to suit the audience. Another key element of this study is the crucial role of the participant motivation. The motivation of participants could be assessed before the program

begins to align program development with the intrinsic and extrinsic motivation of its audience. The thesis also highlighted the importance of adopting an interdisciplinary rather than a multidisciplinary approach to innovation education.

Finally, we believe that educational programs must not only respond to current needs, but also anticipate future changes in the innovation landscape. Continuous adaptation and learning must be part of the DNA of innovation education programs to ensure their relevance and their effectiveness.

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**UNIVERSITÉ CATHOLIQUE DE LOUVAIN**  
Louvain School of Management

Place des Doyens, 1 bte L2.01.01, 1348 Louvain-la-Neuve  
Boulevard Emile Devreux 6, 6000 Charleroi, Belgique  
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