



Scaffolding International Interdisciplinary Innovation Challenges in Higher Education

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Abstract

Higher education institutes are confronted with requirements for change. Enabling graduates to acquire knowledge in a discipline is no longer enough. Graduates nowadays need to acquire future skills, i.e. to be able to tackle ill-defined problems, to collaborate online, internationally, and in inter-disciplinary teams, as well as to develop innovative solutions for society. We present a case study of an innovative learning offer that provided undergraduate students with an action-based learning setting. Students formed virtual, international, inter-disciplinary teams and tackled real-life innovation challenges, proposed to them by non-profit or governmental organizations. The innovation challenges targeted solutions by digital technologies and were meant to enrich the organizations which proposed them, and ultimately society. With this learning offer, our university aimed at internationalizing its third mission. In the study, we focus on the methods applied to guide the students through the collaborative innovation process. Furthermore, we analyze which scaffolding measures were used to make the learning offer sustainable and to enable the university to further foster such future skills. Our results can inform higher education decision-makers and educational designers alike.

Keywords: *Innovation Challenges, Action-based Learning, Future Skills, Reflective Practitioner, Third mission, Internationalization*

1. Introduction

University graduates these days need to acquire future skills, i.e. they need to be able to tackle ill-defined problems, and to collaborate online, internationally, and in inter-disciplinary teams [1]. In addition, universities must enable their graduates to develop innovative solutions for society. Higher education institutes (HEI), thus, are confronted with requirements for change. Enabling graduates to acquire knowledge in a single discipline, following well-defined curricula is no longer enough. HEI increasingly adopt a third mission, next to teaching and research. They become key actors for regional economic and social development, often using quadruple-helix interactions i.e. innovating in close co-operation with industry, government and civil society [2].

We present a case study of an innovative learning offer that was developed in the framework of a project to internationalize the university's third mission. Students from various countries and disciplinary backgrounds formed virtual teams and tackled real-life innovation challenges, proposed to them by non-profit or governmental organizations. In our case study, we focus on the methods applied to guide students through the collaborative innovation processes. In addition, we look at the scaffolding measures applied to foster such novel learning settings.

The case study is based on students' evaluation surveys and reflection exercises, interviews with key stakeholders as well as document analysis of final reports and other material.

2. Future skills – the context

In our rapidly changing world, with growing uncertainty and complexity, decision makers and researchers in higher education are discussing what competencies and skills future graduates need to navigate in such an environment and to solve current global challenges.

A recent Delphi study [1] identifies 16 future skills according to 3 dimensions:

- *Subject:* autonomy, self-initiative, self-management, need/ motivation for achievement, personal agility, autonomous learning competence, self-efficacy
- *Object:* agility, creativity, tolerance for ambiguity, digital literacy, ability to reflect
- *Social:* sense-making, future mindset, cooperation skills, communication competence”

Stifterverband and McKinsey [3] propose 18 skills in 3 categories in their future skills framework, with a strong emphasis on digital skills. According to their study, future graduates all need *basic digital* and *classic* skills and enough specialists should acquire *technological* skills, defined as follows:



- *“Technological skills:* complex data analysis, development of smart hardware/robotics, web development, user-centric designing, conception & administration of networked IT systems, blockchain technology development, tech translation
- *Basic digital skills:* digital literacy, digital interaction, collaboration, agile working, digital learning, digital ethics
- *Classic skills:* problem-solving, creativity, entrepreneurial thinking & self-initiative, adaptability, perseverance”.

From another perspective, entrepreneurial skills seem to be key for dealing with ambiguity, fuzzy boundaries and open innovation processes [4]. According to a recent EU study entrepreneurship is a “transversal competence” which is useful in all areas of life [5]. The resulting entrepreneurship competence framework (EntreComp) consists of 15 competences in 3 areas:

- *“Ideas and opportunities:* Spotting opportunities, creativity, vision, valuing ideas, ethical and sustainable thinking
- *Resources:* Self-awareness and self-efficacy, motivation and perseverance, mobilizing resources, financial and economic literacy, mobilizing others
- *Into action:* Taking the initiative, planning and management, coping with uncertainty, ambiguity and risk, working with others, learning through experience”.

Taking globalization as a starting point, “global citizen education” [6] provides another framework for HEI to shape their learning offer. Broadly speaking, global citizenship education aims at enabling graduates to participate successfully in globalized economies, to contribute actively to solving global problems, and to navigate the challenges that stem from a globally connected, networked society [7]. Skills associated with global citizenship education comprise media and information literacy, critical thinking, foreign language acquisition and communication skills. UNESCO connects global citizenship directly with engagement for UN’s sustainable development goals [8]. In addition, Schön’s concept of “reflective practitioner” [9] is relevant to this discussion.

According to Schön, reflecting both *in* action and *on* action is key to mastering situations of uncertainty and to develop professional expertise.

Despite the differences in these approaches there is also considerable overlap. In any case, these frameworks come with important implications for teaching formats in HEI. Educational designs should facilitate learning that is “empowering, experiential, cooperative and reflective” [4]. Such new teaching formats should be piloted in an agile development process [10].

3. International interdisciplinary innovation challenges – the case study

The online course “*International Virtual Innovation Challenge*” was developed within the framework of “*GlobalXChanges/Challenges (GXC)*”, a project funded by the German Academic Exchange Service (DAAD). GXC originally was meant to create a program of short-term international internships to internationalize the university’s third mission. The pandemic disrupted this plan and instead GXC focussed on designing an online course to reach the same goal, just as many HEI had to convert their student mobility projects to online formats [11].

3.1 Educational design

The online course was piloted as a 10-week action-learning course with real-life challenges to be solved in international virtual teams. Students could apply for the course from all study tracks and from our international partner universities.

The curriculum design combined global citizenship education with promoting entrepreneurial competences as laid out in the EntreComp framework [5] and digital skills, in particular agile project management and digital prototyping of web or mobile applications.

Key element of the design were *innovation challenges* proposed by public governmental and non-governmental organizations.

The innovation challenges targeted solutions by digital technologies and were meant to enrich the organizations which proposed them, and ultimately society. Participating students were grouped into international, interdisciplinary teams to tackle the challenges and prototype digital solutions (Table 1).

Partner organization	Innovation challenge proposed
Municipal Labour Department	How can municipalities, through digital solutions, motivate local companies towards climate protection, in times of crisis?
National Ski Federation	How could we digitally connect/engage ski enthusiasts in a way that adds value to all stakeholders and leads to an active and interconnected ski community?
Municipal Branch of a Youth Association	The future of youth participation: How to empower the youngsters?

Table 1: Innovation challenges as key element of the educational design

Two educators with a background of computer science and entrepreneurship respectively taught the course, using a flipped classroom design. A learning management system provided pre-recorded video lectures and reading material for content input, and was complemented by weekly live sessions via video conferencing. Moreover, student teams collaborated on a shared data repository (GitHub) that also was used for the final documentation.

3.2 Scaffolding in place

Such a learning setting is highly demanding for students and often in contrast to their previous study experiences. Thus, various support measures scaffolding students' learning experience were implemented.

- Students were provided with a design thinking-based innovation process they could follow to tackle the innovation challenge and that clearly structured the 10-week-curriculum (Fig.1)
- For the international, interdisciplinary and virtual team work, each student team had coaching sessions with an external coach to support them with team building, conflict-resolution, agile project management and reflecting on the learning experience.
- For prototyping digital solutions, no or low code tools were offered to provide a low threshold approach, especially for the students without computer science backgrounds (Figma, Glide, or Bubble).
- To benefit from the action-based learning setting students were asked for a final reflective report

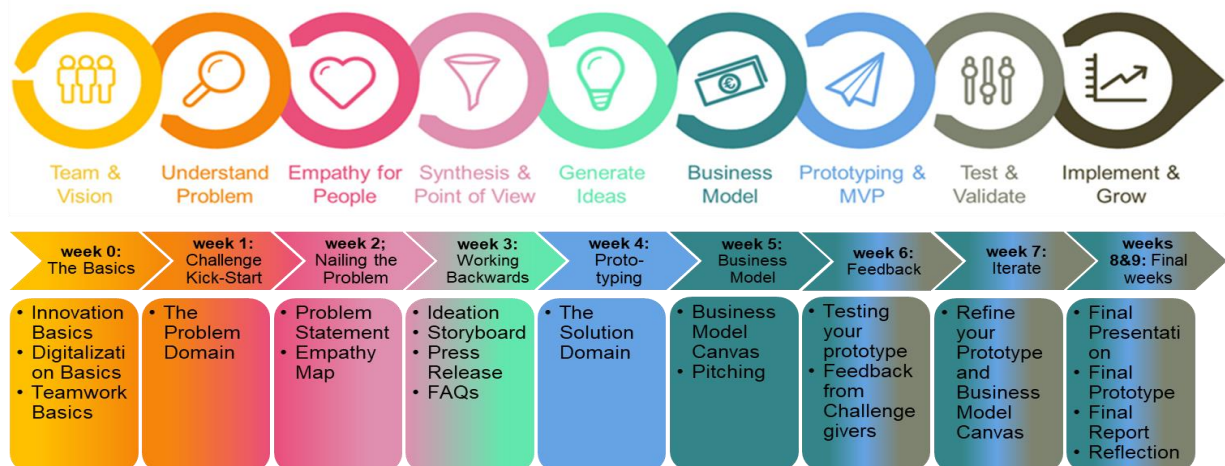


Figure 1. Innovation process and the 10-week course curriculum

At a second level of scaffolding, various measures were in place to ease the pathway to similar future endeavors.

- Experience and knowledge gained are documented in an easy-to access format, e.g. a storytelling based video documentation; external coaches provided a joint reflection report to capture their perspective
- All pre-recorded video lectures are stored in a repository platform, ready-to-reuse, so that any university member can link to them in their future (online) courses
- After the end of the course, each team's documentation is published open-access so that challenge givers can further work on it and potential future challenge givers can get inspired by students' work



4. Evaluation – results and discussion

The pilot course had 41 students from 8 countries and mixed disciplines ranging from computer science to anthropology, political science or biomedicine. However, the majority had a background in computer science, information systems or engineering (63%), 44% identified as female. All students finished the course successfully. 10 student teams worked on the 3 challenges and each produced a prototyped solution to present to the challenge giver. For the climate protection challenge team 1, for example, prototyped a mobile and desktop carbon footprint calculator that allows companies to easily visualize their CO₂ consumption.

To discuss the evaluation results, we will use the attributes that were proposed for learning that helps to acquire future skills [4] and look at how the scaffolding in place might have contributed to realizing these attributes.

Empowering: The fact as such that students were entrusted with a real-life challenge proposed by partner organizations outside the university has an empowering dimension for students, as one of the educators pointed out. All teams delivered a prototyped solution and the challenge givers, generally, were impressed by the students' solutions and their professional interactions. The structured innovation process mapped to the different course weeks seems to have supported this overall success, although some students experienced the time-lines as tough. Furthermore, all challenge giver organizations decided to invest further in the prototyped solutions. One of them will take part in the second edition of the course with a new challenge. With the help of the no or low code tools, students actually could arrive at a product that could be presented and received appreciation. Students highlighted in their course evaluation that solving the challenges was a real life meaningful experience. They felt they contributed towards something that actually could be implemented in the future.

Experiential: The course had an action-based learning setting and a hands-on approach that all students took up and appreciated. In the evaluation students emphasized that they went through an entire innovation cycle and experienced prototyping a solution and thereby appropriating a great variety of useful tools. In addition, students reported to have improved their entrepreneurial skills. Students' perceived development of their entrepreneurial mind-set showed particularly high scores in the dimensions of *planning*, *marshalling resources* and *managing ambiguity* when compared to courses of a similar content area but without partner organizations as challenge givers.

Collaborative: The learning that stemmed from the virtual teamwork experience was the most valued aspect in their overall positive evaluation of the course. Only 4 students reported team conflicts. The main challenge faced by the students in their teamwork were the time zones (up to 10 time zones apart). Overall, students felt they had increased their network and improved their intercultural skills. The weekly coaching sessions with a focus on team building and process reflection were assessed as highly valuable for the overall positive experience of the collaboration.

Reflective: The coaching sessions focussed on process reflection in terms of personal growth, teamwork and the innovation phases. In their final reflections, students highlighted the value of this support and the external perspective. The reflection assignment at the end of the course was introduced with no further explanation of its relevance and did not suggest a certain structure and might seemed to have been perceived by many as yet another assignment. The educators noted that students did not directly know how to tackle this assignment. For a second edition of the course it was decided to add input on the significance and methods of reflection to the course content.

Scaffolding for future endeavours: university management appreciated that all resources are re-usable, hence, GXC contributed to the university's digital transformation. In addition, management acknowledged GXC's efforts to open-access documentation of project results as well as the active search for synergies with other programs in the university's quadruple-helix interactions.

5. Conclusions

The case study shows that HEI can successfully respond to the current requirements for change. Novel educational designs that foster empowering, experiential, collaborative and reflective learning and involve international partner universities as well as partner organizations from industry, government and civil society enable graduates to acquire future skills and promote global citizenship. In this way HEI' third mission can be internationalized to the benefits of all stakeholders involved.

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