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MINNO® Innovation Project: A Multidisciplinary way to Develop Innovation Competences

Laura-Maija Hero
Metropolia University for Applied Sciences, Finland
laura-maija.hero@metropolia.fi

1. Introduction to the objectives of MINNO®

MINNO® Innovation project is a 10 ECTS (European credit transfer system) multidisciplinary learning program implemented in every bachelor students' curricula in Metropolia University for Applied Sciences in Finland (www.metropolia.fi). Metropolia UAS is Finland's largest UAS that educates in the fields of culture, business, health care and social services and technology, with over 16,000 students and 67 degree programs. MINNO® is conducted via an education–work collaboration. The project course is mandatory for all students because, in the university's view, innovation is important in all professional fields. For example, social problems need innovative solutions such as new products, services and operating models that produce considerable value in terms of health, wellbeing, culture etc. The project's explicit aim for the students is to build novel solutions, products, services or processes to resolve the open challenges presented by companies and other work organisations. The duration of the project courses ranges from 7 to 14 weeks and is coached by teachers from the university.

Course contents include:
- The concept of innovation, development work management and building a development team.
- Collaborative project and innovation work and assessment: brainstorming, future-oriented concepting and planning, customer

> and user understanding, contracts and copyrights, communicating, publishing, productisation, marketing and implementation planning.
> - Multidisciplinary teamwork, stakeholder activities and networking.
> - Innovation development tools and methods.

MINNO® is based on the thinking of innovation development and the processes and collaborative networks they require. An innovation project is a social phenomenon that brings the competence of several individuals together through social processes supported by shared resources. An innovation project is a social process through which a novel idea is turned into a practical reality (e.g. Taatila, Suomala, Siltala and Keskinen 2006). Innovation project activities are designed by teachers together with firms and other working life organisations as project-based development activities that can be called pedagogical innovation processes (see Lepistö & Lindfors, 2015; Hero, 2019). A pedagogical innovation process is understood as an authentic learning activity in which collaboratively created ideas are transformed into a concrete end result, prototyped and tested, and implemented to convey value in the surrounding world through interactions with several stakeholders (cf. Sawyer, 2006). At the centre of the activity is a problem or challenge from working life and an object-oriented goal to produce a novel solution for such a problem.

The possibility of a new object—a product or service, for example—is based on the complementarity of the knowledge and resources of the participants involved (Miettinen & Lehenkari, 2016; O'Reilly et al., 1998). Therefore, multidisciplinary teams are used as an approach to organise the MINNO® Innovation projects. This transformation from an individual-centred to a systemic and socio-cultural approach in organising learning sets the starting point for MINNO® as an activity system. From a socio-cultural perspective, the focus is on collaborative knowledge creation (e.g. Hakkarainen et al., 2004), as well as the social processes taking place in the course of creating and implementing something new.

The "learning subject" is not only one individual student, as all parties in the network are faced with the same authentic, open and vague problem. The "learning subject" in the activity system (Engeström, 1987) is rather a

collaborative network consisting of e.g. students from different fields, even from other grades and institutions, working-life representatives from companies and public institutions as partners, teachers from different fields than one's own, the end-users of the developed product, other teams and possibly other networks. The teacher's role is, for example, to aid in recognising competence, offer tools for it, facilitate the solution development networks and work and balance conflict if necessary, to name a few.

2. The infrastructure

The infrastructure comprises teachers, students from different disciplines, customers from companies and organizations giving authentic challenges and the networks students establish themselves for the success of the project and the tools for innovating and assessment. In the beginning, students get to choose their preferred project challenge (see figure 1).
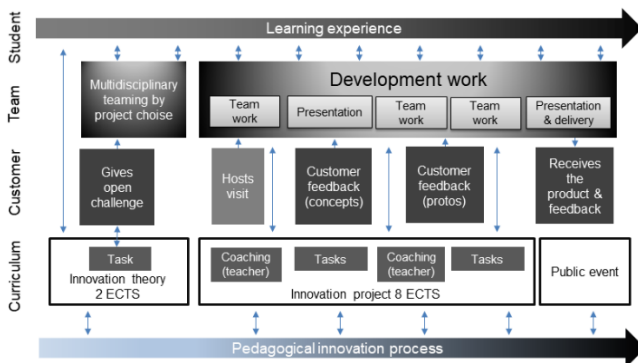

Figure 1: MINNO® Innovation project pedagogical outline.

To ensure multidisciplinary participation, students choose 3-4 project challenges in no preference order. The coordinators organize 20-30 students from different fields of study to one project challenge owned and facilitated by one teacher (or a teacher pair) depending on allocated resource, e.g. designated working hours. Projects start with joint seminar on each campus (Metropolia UAS has 4 major campuses) or online in Zoom. The students divide into multidisciplinary teams of appr. 5 students that are as heterogeneous as possible, according to the students' study disciplines and choice of project.

At the centre of the activity is a real-world problem or opportunity from working life (figure 2).
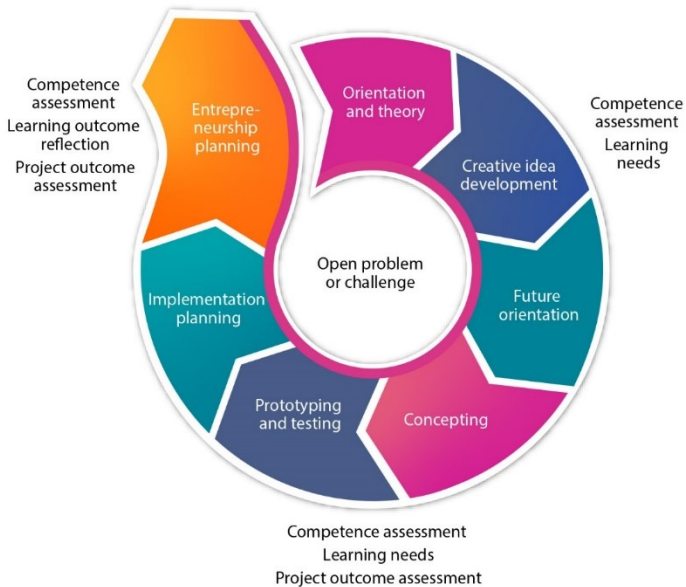

Figure 2: MINNO® is a complete innovation development process implemented in the curricula of 16000 students in Metropolia UAS in Finland. Seen from the teachers' perspective, it mainly follows a pedagogical innovation process (Hero, 2019). From the students perspective the process is more implicit, as the students invent, apply and develop the process for their learning and manage the work of their own team.

The goal is to produce a concrete and implemented novel solution to an authentic problem. Open challenges as tasks for the projects come from companies, public organisations, development projects, associations or foundations, even social media communities. The project outcome is not determined in advance. E.g. During 2017 in the fields of healthcare, wellbeing and cultural management over 50 open tasks were given by various organisations. The open challenges were e.g. The city for babies? How to maintain wellbeing in the forest industry. How can we prevent ordinary immigrants from becoming radicalised? New services for a yoga studio, new

simulations for first aid services – how can we reduce the loneliness of the youth? New gaming solutions for a children's hospital.

The process includes orientation and theory along the way in the form of innovation toolbox, team project work, pitches, prototyping, research and testing, a final public event and delivery to the customer. Teams are normally tutored for 1–2 days a week, and the customers give feedback on the solutions approximately 2–5 times. Typically, a team's project outcome includes a prototype and its test results with productisation and a go-to-market, sales, marketing implementation plan. The teachers act as facilitators and offer tools for innovating. The teachers also help in networking and finding new partners in the working life is necessary.

Today, at the age of Covid-19 pandemia, the teams are tutored and they meet in Zoom or Teams online platform. This change has not been a challenge for the team work, but . On the contrary: Most students enjoy the lack of travelling due to the mixing of the students from different campuses.

Figure 3: An example of MINNO. A multidisciplinary team of a first year ICT student, 2 cultural managers, one social services students and one health student developed a working prototype of a Finnish sauna and wood chopping VR game in a 7 week MINNO. They were challenged by Helsinki XR center: "How could we engage our foreign visitors?"

Figure 4: An example of MINNO. A multidisciplinary team of one radiography, one cultural manager, one social services and one occupational therapy student were challenged by a Finnish university to solve the problem of low student motivation. The team developed a digital pet that grows according to earned credits. The pet can also be seen standing on the floor as it can take an AR (augmented reality) form as well.

Figure 5: A multidisciplinary team developed a 3D board game with task cards and a mountain to climb for K12 students to learn collaboration and team working skills at Itäkeskus school. The game has received good feedback and is taken into use.

The outcomes are normally documented in posters and product or service manual documents, prototypes and supporting communications and

marketing deliverables. These materials are presented and delivered to companies by the teams. E.g. During 2017 the team project outcomes varied from motion-sensor health-game prototypes and new types of documentary series, to tested event models involving volunteer staff, etc. Some outcomes were productisation manuals with, for example, a depicted production network and branding outline to help the customer implement the solution afterwards. During 2018-2020 the outcomes have become more and more service and experience oriented digital and technical solutions in e.g. health and culture campuses. Examples include e.g. a virtual reality (VR) documentary series for a city museum, augmented reality (AR) solution for a restaurant museum and a digitally growing pet in a mobile device to boost student motivation for an university. During Covid-19 pandemia in the spring 2020, the deliverables have been even more digital, almost nothing was printed, physically designed or built. However, the collaborative production of the materials has ensured the development of technical design skills even for those who did not have these skills in advance. Some of these novel solutions are fully commercialised later in the customer organizations, and it is common that several start-up companies emerge every year, already during studies of the participating students. Some of the companies offer work placement for the students they have worked with in the MINNO® Innovation project. This way the project acts as a stepping stone towards working life.

3. Overcoming challenges

The MINNO® Innovation project program has been in Metropolias' curricula over 10 years and it is a part of the management strategy of the university. There has been challenges in implementing it in a multidisciplinary form. The challenges have mainly concerned the organization of the multidisciplinary collaboration for the student teams. However, there are several learnings and good practices developed along the way. First, the strategic support from the university management is crucial. The strategic intent ensures the infrastructure in the large university and its multi-campus environment. MINNO® is implemented in every students' curricula, the coordinators for each of the 67 degree programs in the university are named to organize the teacher collaboration, the collection of challenges from companies and the teachers are resourced and put in collaboration several months before the projects start. Teacher collaboration and pair tutoring promotes continuous professional learning of the teachers and sheering of good practices. In

addition, the strategic status of the MINNO® program ensures continuous development of the working life and company networks and the project implementations.

Second, the weekly curriculum is a true challenge. It is very hard to organize a 270 hour program course so that the students coming from different degrees are able to meet and work together all this time, even full days. Our good practise has been, that we reserve 4 full days during 7 weeks in the calendar to everybody attending. The coodinators communicate these dates to all management staff already one year in before. This helps in preparing the weekly curricula. Tutoring is organized normally 1-2 times a week, the rest of the time multidisciplinary teams work where ever they find it best. A good practise has been, that the week begins with innovation tools and theories, then 2 days teamwork and the week ends with coaching by the firms and teachers.

Third, the assessment of the course is a challenge. In one hand, the assessment should be conducted on individual level per student as the curriculum text is written per student and the grading system is from 1 to 5. In turn, the work is done in a team. The teacher does not recognize necessarily the input64 and performance, nor the competence development, of a single student. Our good assessment practises include multi-form integrated assessment practices: Self-, peer-, customer, output and teacher evaluations that start from day one and continue the whole 7 week process. After all, the aim of the assessment is to make learning visible and understood for all participant of the innovation network.

We have developed and we use e.g. 1) a pre-post self-assessment survey to measure experienced competence level before the project and after it. This allows us to integrate research in the process, and collect continuous quantitative data. This helps also students to orientate in self-reflection. In the beginning of the multidisciplinary teamwork, the team members do not know each other. Some teachers offer 2) InnoCards for teams to workshop. InnoCards allows a new team to make visible and evaluate skills and development needs in the team at different stages of the project. InnoCards are used to develop a common understanding of existing competences and

to identify one's own and the group's strengths, weaknesses and development needs during the project process. The cards are divided into colors according to the main categories of individual innovation competence based on 7 categories found in supporting research (Hero, 2019). The goal for the user is to get cards of as many colours as possible among their strengths during the learning process. The group is instructed to pay attention to and discuss the strengths of others in addition to their own qualities, weaknesses, areas of development as well as those competencies that have developed. The camcorder or cell phone circulates in the team: a person that isn't talking at the moment records what is said. The videos can be collected in an electronic team portfolio web page (web page development can thus be integrated as a learning assignment) or otherwise delivered as a study assignment (Hero, 2020).

3) A shark tank type pitching event is organized in the concept phase to assess the project work, team and outcomes. The teams develop three concepts and the companies and their networks comment and coach the teams to pick one solution for development further. The teams pitch again in the end of the project and deliver the outcomes to the customer firm. 4) A teacher diary is available to document the learnings on team and individual level, 5) A personal weekly student diary is collected to assess the individual experience of one student and the ability to reflect on his or her own learning. This helps teachers in their evaluation. After all, innovation processes are learning processes an sich also in the working life. 6) Grades can be negotiated among the team in the end of the project using the course assessment criteria as a template. This helps teams to weight also their input: if one of the team members has acted as a "free rider", the team is able to discuss this openly and professionally and adjust the grade proposal accordingly. We have noticed that the team is not too loyal to free riders, but they help the free rider to compensate and pass. This also helps teachers in their evaluation.

4. How MINNO® is received by the students

MINNO® student diaries were studied to unfold students' learning experience, to help teachers and curriculum designers to organize optimal conditions and processes, and support competence development (Hero & Lindfors, 2019). The study shows an image of the students' agency in a multidisciplinary innovation project, the contradictions students

encountered, the innovation process phases they could conceptualise, and the competences they could recognise. MINNO® is a pedagogical way to connect school to the practises of society and work life. Working at the boundaries of different disciplines and networks seems to push students to act creatively and proactively and take responsibility for their actions and learning. The negative experiences related to unevenly distributed workload, inadequate input from the customer and feelings of uncertainty and unclarity of the task. Frustration was expressed, but there were also many references to solve these problems and learning related to it. Contradictions and tensions occur and students have to solve them. Findings indicate that conflicts and contradictions do not have a drastically negative effect, but offer a collaborative problem solving environment and opportunity for personal development. The multidisciplinarity of the innovation process seemed to promote this.

Most of the students seem to have been very engaged in the project work, but some diaries expressed lack of motivation due to personal situation and the complexity of multidisciplinary collaboration. Nevertheless, the diaries provided a rich view of students' reflections. The findings show a picture of a real-life learning experience of active experimentation, where the learning outcome is impossible to be defined in advance in much detail, where the immersion and engagement to project work is obvious and the problem space is unlimited and unpredictable. (Hero & Lindfors, 2019)

5. The learning outcomes

The learning outcomes of MINNO® are targeted to include the collaborative and individual perspectives, and the process and content knowledge of innovation development activity. In addition, the learning outcomes include the individual innovation competence aim understood as developing in collaborative contexts. Individual innovation competence is defined as 1) personal characteristics such as self-esteem, self-management, achievement orientation, motivation and engagement, flexibility and responsibility, 2) future orientation, 3) creative thinking skills, 4) social skills such as networking, collaboration and communication skills, 5) development project management skills such as leadership skills (e.g. actively building team competence, encouraging and coaching others), 6) one's own and other's discipline content knowledge, and 7) concretisation and implementation

planning skills such as making, productisation, sales, marketing and entrepreneurship planning (based on Hero et al., 2017; Hero, 2019).

On completion of MINNO® the student are be able to 1) responsibly develop innovative practical and concrete solutions, practices, products or services with multidisciplinary partners to meet the diverse future needs and current challenges in the Helsinki Metropolitan area; 2) define the concept of innovation and take development methods into use; 3) apply project and network-based work, creativity and competence in regional, national or international development work; 4) use his or her personal skills and abilities to work in multidisciplinary collaboration and working environment; 5) create a culture of cooperation and negotiation for successful teamwork; 6) use his or her skills in problem solving, collaboration, technical and communication skills to support the collaborative development processes and joint decision making of the team.

The individual perspective is regarded as important as the assessment of learning is still conducted individually for each student even though the learning happens in teams and networked systems. The competences that students could name in the diary study related to content knowledge, different personal characteristics, emerging leadership skills, creativity, future orientation, technical, crafting and testing skills and innovation concretisation and implementation-related skills such as productisation, marketing, sales and entrepreneurship planning skills. However, future orientation and implementation planning skills were found to be weaker than other variables in the data were. (Hero & Lindfors, 2019)

The self-evaluated learning outcomes were studied also in 2020 with a pre-post survey. The survey propositions were developed based on previous studies on individual innovation competence (Hero et al., 2017; Hero & Lindfors, 2019; Hero, 2019) and validated in several phases before the survey was conducted. N=400 students were invited to this voluntary survey on the first day of the 7 week project course, and again in the same survey on the last day. N=53 pre and post answers could be matched. The study shows development in all innovation competence areas, but the most developed seems to be concretisation and implementation planning skills such as

making, productisation, sales, marketing and entrepreneurship planning skills. However, these preliminary results are not reported yet and a more detailed analysis is still underway. By conducting this survey in each MINNO® project program it is possible to adjust the pedagogy to ensure right type of learning experience for innovation.

6. Plans to further develop MINNO®

In conclusion, based on the findings from our studies and practical teaching in MINNO®, we recommend to other universities that the project challenge is an authentic one from the working life. The curriculum design enables student-led pedagogical innovation processes that involve a whole path from future thinking and idea development, through to prototyping, to implementation planning of the novel solution. Teachers and teaching should promote deep comprehension of the innovation process, monitor and ease the pain of conflict if it threatens motivation, help in recognising gaps in individual competences and development needs, promote more future-oriented, concrete and implementable outcomes, and facilitate in bridging between the project and entrepreneurship. In addition, teachers should focus on multiple assessment opportunities and tools from the beginning to the end of the project work.

We have just completed a curriculum renewal process as a practical implication of our studies and coordinator collaboration workshops. The curriculum text emphasises now more the future orientation, technical skills and innovation implementation planning skills. It emphasises the multidisciplinary nature of the project. Now single discipline programs should be replaced by multidisciplinary team implementations. This should also allow for more concrete and practical products and services from the student teams that are more ready for further development or even sales in the customer companies. This way the new products and services developed together with students also create new work and more business. They also allow for a pressure test of the team: Could the team be ready for entrepreneurship? In the next MINNO® project courses the teaching will focus more on ensuring multidisciplinarity of the teams, bridging from innovation to entrepreneurship and developing MINNO® teachers pedagogical know-how. We will also develop a MINNO® teachers' certificate to ensure the quality of coaching in every campus.

In addition, we have launched a research group to develop new assessment tools, study the effects of the MINNO® in the surrounding society and the companies also internationally with partnering universities. The effects to the areal innovation competence here in Finland and the capital area are expected to be significant, but hard to measure and make visible. The additional value is not only economical, but also social, ecological, environmental and sustainability value, health and wellbeing value and competence and knowledge excellence.

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Author Biography

PhD Laura-Maija Hero acts as a senior lecturer and a RDI project manager in Metropolia University of Applied Sciences in Finland. She is a research project lead for Minno Effects - research team that studies the social and economical effects of innovation pedagogy. She teaches cultural management and innovation. She is also a visiting post-doctoral researcher in University of Turku. Previously she has worked in international technology business as a marketing manager. Her publications can be found https://wiki.metropolia.fi/display/~lauramh/Laura-Maija+Hero%3A+Julkaisut+Publications.