INTERDISCIPLINARY TEAMWORK AS A BASIS FOR INNOVATION COMPETENCES DEVELOPMENT

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ABSTRACT

Experts such as engineers in contemporary, global context often work in teams with members from various areas of expertise and professional backgrounds in order to develop new innovative products and services. That is why new training methods with an interdisciplinary approach are increasingly needed and developed. Our paper presents how we developed an interdisciplinary, work-oriented learning project over the years 2014-2017 and what results we got. We aim to provide pedagogical insights on how to support the development of innovation competences. The learning project was originally implemented in the degree programs of engineering and international business at Vamk in Finland. In addition, we compare these results with current experiences received during years 2018-2020, when a similar cross-disciplinary, work-oriented learning project has been implemented at Seamk in Finland.

An interdisciplinary approach means that people work together as a team, presenting their own field of expertise and integrating each other's professional perspectives. Interdisciplinary teams develop individual and collective decision-making and help team members to understand and appreciate other disciplines.

Findings of these qualitative learning experiments will be presented. Conclusions as to integrate diversity management at the university level and suggestions for the development of the engineering curriculum will be provided. Practical tips for teachers organizing interdisciplinary learning projects will be given.

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1 INTRODUCTION

In the present era, an increasing number of companies are hiring not only deeply skilled specialists but also experts who are skilled to work in interdisciplinary teams. In the near future, organizations are emphasizing interpersonal, cognitive and systems thinking skills in their recruitment [1]. More specifically, these interdisciplinary experts are expected to carry and develop metaskills of networking, critical thinking and team leadership [2]. In order to match with these skills of future employees, new educational methods are needed where interdisciplinary approach is used as a pedagogical core. Often, the literature on interdisciplinary collaboration seems to be focused on the sociocultural aspects, for instance, how social interaction is developed and supported in interdisciplinary context. However, interdisciplinarity should not be narrowed to the coordination of various tasks, but a specific attention should be put on how skills and knowledge can be transferred across boundaries. [3]. This is where our paper aims to contribute by describing how interdisciplinary learning supports and enhances the interdisciplinary cohesion and transfer of innovation competences.In addition, we consider design thinking as a value-adding educational tool, by which teachers can not only support practice-oriented learning of students but also through which teachers can transfer innovation competences to be used in pedagogical development.

2 METHODOLOGY AND ANALYSIS

We base our analysis on the methodological process of design thinking through which we as an interdisciplinary teacher team defined, developed and implemented interdisciplinary, work-oriented learning projects at two universities of applied sciences in Finland (Vamk and Seamk).

2.1 Project-based learning combined with design thinking

In general, project-based learning is based on cases provided by companies, in order to give authentic tasks for the students to solve open-ended problems in a cooperative context. Real world business projects and cases are very often emphasized in studies at universities of applied sciences. Project-based learning can be seen to have various, positive impacts, for instance, on skills related to reflection and interaction as well as critical thinking and problem-solving proficiencies. Still, project-based learning often is implemented within rather than across sectors. For example, technology students implement a technology-related project, rather than a project, where the main emphasis is on building new business models. On the other hand, when there is an interdisciplinary project, it might be difficult to find a company which gives a problem defined from various professional perspectives. [4]

In order to tackle these type of expectations, needs and challenges, we have combined an interdisciplinary and design thinking approach when planning and implementing our learning projects. The following figure illustrates our design process, which starts by discovering what are our possibilities, defining the design and contents of learning, implementing the learning project and finally reflecting the experiences and results.

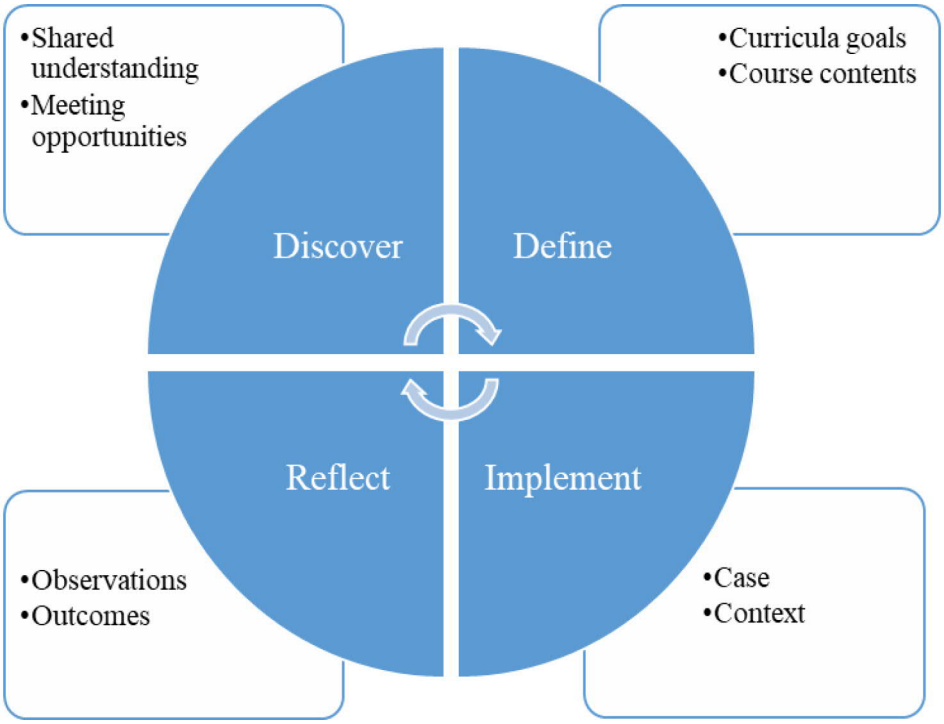

Fig. 1. Design Thinking Process Used in Planning and Implementation

2.2 Discovering collaborational possibilities

When starting to plan an interdisciplinary approach, it is vital to build a ground for shared understanding, as for instance studies in collaborative design and design thinking suggest [5]. The planning phase for our interdisciplinary learning project might not have started without an EU funded project, in which we together with several European partners developed a multi-sectoral learning environment for creativity. In addition, one of us participated an EU IP programme, where also international partners interested in similar approach were found.

To create shared understanding, we as teachers needed these meeting opportunities, based on which common interests could be identified. We had several discussions on requirements for future employees in our fields and what type of holistic understanding is required by the competitive and complex business environment. We realized that as well as companies aim towards continuous, open innovation across industries, we also as teachers should develop an open, learning platform for students to learn collaboration and to establish shared understanding across different study fields.

2.3 Defining the course design

When we had shared a common understanding of the requirements and possibilities of a joint interdisciplinary learning project, we started designing how to implement our idea in practice. We can distinguish between intended, implemented and attained curriculum. The intended curriculum refers to the written and formal curriculum, the implemented curriculum refers to the operational curriculum perceived and used by

teachers in the classroom and attained curriculum means the learning experiences perceived by the students [6].

Since the intended curriculum was not going to be revised, we had to determine which existing courses could be integrated into the project. We had to review and decide the operational curriculum: which current courses could be used so that the course content and learning objectives apply to interdisciplinary project learning. In addition, course schedules required joint planning and flexibility, in order to match different study programmes together.

At the beginning, one of the main goals was to develop the innovation competences of engineering students with those of international business students. Later, when other study fields were also involved, we were keeping the same goal to develop students' creative and interdisciplinary competences. We realized that establishing not only interdisciplinary, but also multicultural teams could bring benefits like increased flexibility in problem solving, diversity of ideas and creative ways of thinking, and the development of personal, social and cognitive capabilities. We also decided that the joint project would be a one-week intensive course. This was not only a matter of operational decision, but also an acknowledged choice, as innovation projects often require experimental processes and intensive ways of working.

2.4 Implementation and activities compared

The first implementation in 2014 was a pilot course at Vamk where we tested our interdisciplinary learning approach. By collaborating with local companies, we created a presentation program where business experts, international partners and teachers provided insights on chosen topics. In addition to attending the presentation, the students were actively working for a five day period. We defined interdisciplinary and multicultural student teams (from engineering and international business programs) in advance, and we organized a half-day team meeting before the formal intensive week. When starting the intensive week, the teams received instructions for their team task: each team was expected to plan how to market a particular technical product or service in the country of their choice. So, the pilot project had not a single, specifically defined case for all teams, but teams had to define their product or service and the problem to be solved with it. As we were not able to pre-define their case, we were not able to define a precise model how to coach the teams in their tasks. However, we defined the process how they should approach their task, and this process model was a helpful tool for both teachers and students.

When planning our next implementation in 2015 at the same university, we considered our experiences from the previous year. First of all, we decided to collaborate closely with a local business. We selected an innovative SME as our partner and had meetings with them beforehand in order to create a mutual understanding how the project could be executed. This company instructed students to design how to bring their new energy related product concept to international markets. Otherwise, we followed the practices of the previous year. Coaching student teams was much more effective based on previous year's experiences.

The third implementation at Vamk in 2016 was based on the same SME company case. However, we changed the execution by involving a group of business students from a German university (HdWM in Mannheim), in addition to our students from engineering and international business programs at Vamk. The case was further developed by increasing the challenges of internationalization for the task. In addition, we developed the schedule in order to create the best possible conditions for teamwork, supported by company visits and creative evening program.
In 2017, we travelled with our students (from Vamk`s engineering and internationl business programs) to Mannheim, Germany, where our partner university (HdWM) designed the intensive week program. They also negotiated with a local SME partner, which gave a very difficult project task for the students. The student teams had to plan how the company's current product range could create new collaborative relationships for the company in entirely new industries. A pedagogic aim was also to follow how team performance is affected by a more challenging goal, and how this affects the methods of communication and coaching.
During 2018, 2019 and 2020, a similar interdisciplinary approach has been adapted at Seamk in Finland. One of us has been acting as a coordinator for this learning project, which continues in the future as well and is implemented on a yearly basis. It is organized as an intensive week, and involves all, over 700 first-year students of Seamk. Students (from engineering, business and culture programs) are split into twelve groups each of which are coached by an interdisciplinary teacher team. In each of these groups, students form interdisciplinary teams of five to six students. Each group focuses on a specific company case, provided by local companies representing different industries. The given cases can focus on, for example, to innovate new customer segments for a current service or to innovate current product for new markets as well as to find new ideas for future business models. The pedagogic model is based on developing the students' innovation competences, supported by design thinking, service design methods and specific case objectives.

2.5 Findings on the innovation competences

After each learning project, we have analyzed student responses, based on both quantitative and qualitative research methods. The quantitative, short surveys, which the students have responded to, have had some variation in survey outline and questions each year. The comparison of the numerical results is not viable in this short paper, instead, we summarize student responses in qualitative manner. In conclusion, student reflections show that learning projects have brought more cultural awareness and developed their problem-solving, cognitive and innovation skills. Students also seem to evaluate they have developed both interpersonal skills as a team member and as their personal expertise in various subject areas. Also, their time management and presentation skills are perceived to be improved. In addition, not only open-minded teamwork, but also open-minded coaching seems to become more important when the diversity of students, professions and nationalities is increased.

Transfer of innovative competences in interdisciplinary project work can definitely include various factors which have to be carefully considered, as described in a specific student reflection: *"Working in an interdisciplinary team can easily feel like walking on thin ice – having to be extremely careful so that the surface won't crack."* In order to be able to innovate in an interdisciplinary team, you need to dig deeper into the knowledge from different disciplines. As critical aspects related to innovation competences, students highlighted, for example, difficulties in understanding each other's ways of working and the challenges of defining common goals. We might assume that these difficulties are closely related to differences of perceptions and cognitions, which have also been studied by researchers from cognitive and cultural fields [7]. Your professional background affects how you perceive and understand the environment and context. The more similar you are with other people, the easier it might be to innovate together. However, transfer of innovative knowledge needs perceptual differences which can construct shared understanding more effectively. A particular student comment reflects this issue: *"I felt the other members did not understand my point of view, which was very frustrating. But I kept explaining, and finally, I think we started to look at the same direction. At least they said they understood my point of view…"*

In terms of innovation competences, interdisciplinarity might also be transferred to multipotentiality [8]. Instead of acting in a single, professional role in an interdisciplinary context, each person might need to educate themselves in multiple, cross-border skills and knowledge. This clearly poses a new possibility and challenge for interdisciplinary educational programmes: are we expected to educate, for instance, engineering versus business students separately or should we aim for new professionals with multiple focuses in their study path? As a student comment reflects: *"During this team work, I became interested in having some courses in engineering, although I have never thought myself to be interested in any technological studies. I will at least try to find out, if this is possible in my study programme."*

The model we followed when planning and executing our interdisciplinary study project integrated and benefited from design thinking process. We emphasize this model as one of our findings, which supports the development of innovation competences. Design thinking is especially beneficial when there is a wicked problem to be solved, which most often is the focal point in interdisplinary projects. In addition, following desing thinking made us to offer various visualization and ideational methods for the interdisciplinary teams to exploit and test.

3 CONCLUSIONS

The basis for interdisciplinary learning is the ability to be in relation to other learners, which requires effective networking and diversity management skills, and in particular intercultural skills in a global environment. Our results show that interdisciplinary and multicultural project learning environments develop metaskills needed for innovative behaviour, for instance, cultural knowledge, creative thinking, team leadership and planning skills. It can be suggested that higher education curricula should not only

continue the existing interdisciplinary project courses but create new ones where students intensively learn collaborating across boarders and develop essential innovative competences for future professionalism.

Interdisciplinary teamwork develop both individual and collective problem-solving abilities and help to understand the added value provided by other disciplines. The basis for interdisciplinary learning is the ability to interact with other learners, which requires interpersonal skills as well as understanding of diversity and cross-cultural perspectives and possibilities. When students from various disciplines build a shared understanding and responsibility, they can form an engaging and empowering relationship with one another.

To conclude, interdisciplinary innovation projects should be perceived as a method providing growth possibilities for universities, businesses and students. Research evidence from various countries shows that innovative collaboration of businesses and universities is beneficial for all parties, developing their innovation and knowledge management capacities. Companies get new ideas and systematic support for innovation, universities get in-depth knowledge of companies in the region and students strengthen their business relations as well as their practical skills [8]. Universities of applied sciences should not only train students to become experts in their specific sector, but helping them to become skilled in cross-sectoral and open innovation. By supporting the forming of new type of behaviour and attitude towards interdisciplinary innovation, universities can shape the future of their society.

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