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UNIVERSITIES IN INNOVATION ECOSYSTEMS - HIGHER EDUCATION PROVIDES KNOWLEDGE FOR INDIVIDUALS, WORKING LIFE AND SOCIETY

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Abstract

Higher education with strong links to research, development, and innovation (RDI) activities is seen as important both for an individual's ability and for the development of society as whole. Higher education aims to develop both the human capital and the excellence needed to create new jobs, economic growth, and prosperity in the EU. The recent literature on innovation research emphasises service innovations that arise from the combination of different knowledge, skills, ideas, and resources. Thus, it is important to create open and networked innovation ecosystems where higher education institutes, citizens, private and public sector innovate together. All this requires new collaborative innovation models outside the traditional service research areas.

This article describes the development work on higher education pedagogy at Laurea University of Applied Sciences, which aims to reform and develop approaches that link the European Qualifications Framework (EQF) level 7 higher education more closely with RDI activities, as well as strengthen the role of UAS as facilitators of co-creation and shared knowledge-creation processes in open innovation ecosystems. The starting point for the development work was Laurea's pedagogical approach, Learning by developing (LbD), which was operationalized with the conceptual tools and models provided by the trialogical learning framework. The three metaphors of learning (monological, dialogical and trialogical) provide a valuable framework for evaluating pedagogical solutions. We argue that higher education pedagogy (EQF7) should consist of pedagogical solutions based on the different metaphors of learning that should already be considered during the planning phase of the study units.

The research strategy chosen for this study was action research. The action research consisted of three cycles to examine and develop approaches to link EQF7-level UAS education more closely with research and innovation. The main contribution of this paper is a pedagogical model that is highly suited to integrating the three tasks of universities of applied sciences – education, R&D and regional development. The results indicate that higher education institutes have a significant role in the public innovation ecosystem as drivers of national competitiveness. In addition to their educational mission, higher education institutes promote regional development by maintaining networks and orchestrating innovation activities in the ecosystem.

Keywords: higher education pedagogy, knowledge-creation process, trialogical learning

1 INTRODUCTION

The European Commission considers higher education linked to research and innovation to be important for the development of both an individual's ability and for the development of society as whole. Such education develops the human capital and excellence needed to create jobs, economic growth, and prosperity in the EU [12]. The EU has defined three main objectives for research and innovation policy: open innovation, open science, and international cooperation. Open innovation is broadly defined as the involvement of academia and non-scientific experts in the innovation process. By involving more actors from different sectors in the innovation process, information flows more freely and knowledge from different sectors can be used to develop services and products. Open science, on the other hand, refers to a new type of scientific process that emphasises the dissemination of knowledge through digital and collaborative technologies as soon as new knowledge becomes available [11].

In 2017, the Ministry of Education and Culture launched a visioning exercise in Finland, the result of which outlines the direction of development of higher education and research until 2030. The vision aims to 1) raise the level of education, 2) increase opportunities for continuous learning in higher education and 3) increase Finland's research and development intensity. These objectives are pursued through five development programmes aimed at (a) making Finland home to the most skilled

workforce, (b) modernising higher education and the digital service environment, (c) using the expertise of the higher education community to create the best learning and learning environments in the world, (d) making higher education institutions the best places to work in Finland and (e) strengthening cooperation and openness as a resource for research and innovation. Achieving this vision requires the renewal of society, investment in RDI activities that renew citizens' well-being and business life, and the formation of innovation ecosystems [21].

According to the Ministry of Economic Affairs and Employment, Finland's competitiveness and well-being are built on knowledge, research, and innovation. Success in global competition requires the production of new knowledge, innovations that support societal benefits and value creation, and a high level of competence. The Ministry of Education, Science and Culture and the Ministry of Employment and the Economy drew up a national RDI roadmap to promote the achievement of this objective and the resulting sustainable growth, and to create an environment that encourages companies and businesses to invest in RDI activities in Finland. The RDI Roadmap outlines three interlinked strategic development areas: 1) Knowledge: a significant increase in the national level of knowledge and education is seen as a prerequisite for the desired growth in RDI activities. 2) New partnership model: strengthening, expanding, and increasing the impact of RDI activities requires strengthening cooperation between higher education institutions, research institutes, companies and other RDI actors, a new partnership model and the building of broader clusters of excellence and ecosystems. 3) Innovative public sector: RDI activities must be more strongly linked to the development challenges of the public sector and to different policy sectors, their means, and resources. [30]

Universities and research institutes, alongside a small number of companies that invest strongly in RDI, form the basis of Finnish RDI activities. Companies are encouraged to invest a larger share of their turnover in RDI and to increase RDI cooperation with research organisations and the public sector. A new partnership model is needed to support these objectives, bringing together research and the networks that use it into larger clusters and ecosystems of excellence. The new sustainable growth is seen as being based on knowledge, balanced development of RDI activities and partnerships supported by an innovative public sector. [30]

All the education and innovation policy objectives, described above, have challenged higher education institutions, to develop their own practices. In this paper, RDI activities are examined from the perspective of a university of applied sciences (UAS) and as part of their three tasks. The basic mission of an UAS is to provide higher education based on the requirements of working life and its development. In addition, it is responsible for applied research, development and innovation activities and artistic activities that serve the teaching, promote working life and regional development and renew the economic structure of the region. [2]

This article describes the development work on UAS pedagogy at Laurea University of Applied Sciences, which aims to renew and develop models that link EQF7-level UAS education more closely with RDI activities and thus strengthen the role of UAS as facilitators of co-creation and knowledge production processes in open innovation ecosystems. The aim is to develop a pedagogical approach that supports the integration of education and RDI activities by operationalising Laurea's pedagogical approach, Learning by developing (LbD), with the conceptual tools and models provided by Hakkarainen and Paavola's triological learning framework.

2 COLLABORATION AND OPENNESS AS A RESOURCE FOR RESEARCH AND INNOVATION IN UNIVERSITIES OF APPLIED SCIENCES

The growing importance of services in both the private and public sectors [35] highlights the need for new service innovations. Innovation is vital for the success of society, as it increases economic efficiency, generates cost savings, creates new activities, and opens up new export opportunities. Today's services are often multi-channel and digital technologies play a key role, increasing their complexity and making it difficult to manage the customer experience [22]. Through strategic collaboration and transparency, organisations can accelerate the innovation process and improve the quality of its outcomes. In addition, a design approach has started to be applied to service development. Service design has proven to be a very effective and useful approach for putting the customer experience at the center of service development process. Service design also offers approaches, methods, and tools for co-creation. Identifying new service opportunities and generating service innovations will require a new set of skills for future service developers. These expectations have challenged higher education institutions to find new pedagogical approaches and learning methods.

2.1 The paradigm of open innovation in the service ecosystem

New service innovations are created by combining different types of knowledge, skills, ideas, and resources. The increased complexity of service systems and services and the pace of change require organisations to become more agile, creative, and fast at driving innovation [22]. Indeed, it is increasingly difficult for single organisations to develop innovations in complete isolation, which has been a key justification for greater openness and cross-functional co-creation. Over the last 20 years, there has been a strong increase in openness and the use of external resources in the innovation activities of organisations. The paradigm of open innovation, introduced by Chesbrough in 2003, calls for organisations to extend their innovation activities beyond their organisational boundaries and to draw not only on internal ideas but also on external knowledge and information [5]. While traditional business strategy has led firms to develop defence mechanisms against competition to secure their position in the value chain, open innovation is about firms strategically leveraging ecosystems, networks and communities as part of their own innovation activities and creating new value through partnerships [6]. Public administrations have also sought to open up their own development activities and enable new forms of more open collaboration and partnerships (see e.g. Hilgers & Ihl 2010; Mergel & Desouza 2013; Feller et al. 2011; Bakici et al. 2013).

In general, open innovation can not only accelerate innovation and amplify its results [20;7], but also foster shared learning and remove business uncertainty and barriers to new innovation in highly regulated sectors such as health, finance, energy and transport [4]. The European Commission has therefore put the renewed Open Innovation 2.0 model at the heart of Europe's future development. Open Innovation 2.0 builds on previous research and theories, but emphasises the broader involvement of civil society, businesses, the public sector, and academia in the development of society, and thus in increasing prosperity [7]. This underlines the view that innovation is not only necessary for business and economic development, but that innovation should result in value creation for all actors within service ecosystems in every interaction situation. The basis of ecosystem thinking is that an ecosystem, through multi-actor and interactive cooperation, produces more for the same input than the different actors would achieve if they acted alone (Figure 1.). "Ecosystems are built on the interaction between businesses, entrepreneurs, research, public administration and third sector actors. An ecosystem is both a structure and a process of interaction through which complementary actors create value together. The ecosystem is also made up of several parallel network structures, linked by a shared vision and common objectives, and an operational model to guide (strategic roadmap) and implement the implementation of these objectives." [31]. Ecosystem thinking links open innovation and public-private co-creation models.

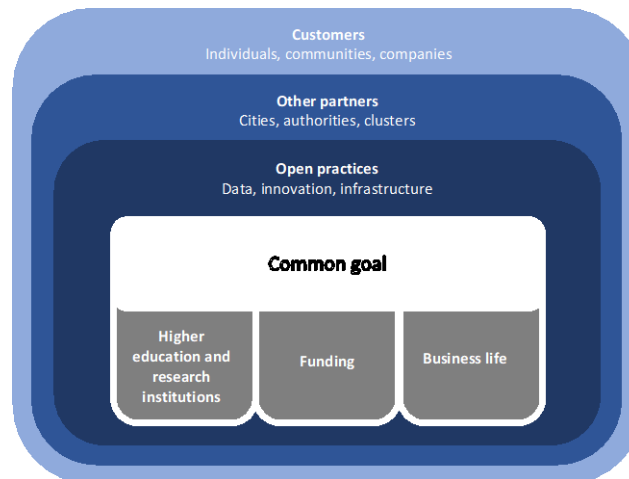


Figure 1: Innovation ecosystems are formed around a common goal [31]

In large service systems customer experience management is hampered by the diversity and complexity of service offerings, channels, and interfaces. This requires new skills outside the traditional service research areas. Service design is seen as a way to promote innovation. The approach provides methods and tools to involve different actors in an open and collaborative innovation process and supports designers and different actors in their creativity and interpretation during the design process.

2.2 Service design for innovation

Service design is a fast-growing, multi-disciplinary approach used by both businesses and public administrations to generate service innovations [22;26]. The central idea behind service design has been to bring together the design, development, and delivery of a service under a single umbrella. The service approach looks at issues such as service offerings, service processes, financial resources, user experience, value creation, and technology. To enable a broad approach, service design combines several disciplines from service business management, design, psychology, operations management and information and communication technology [19;25] into a common problem-solving process that emphasises human-centredness, co-creation, creativity and iterativity [31;29]. Service design can be used to understand the factors that influence value creation from a customer perspective [26], improve customer experience and organisational performance [28;33;1], accelerate service innovation [22] and understand alternative future market scenarios [34].

Service design is based on a comprehensive understanding of the nature of the problem to be solved, thus enabling the construction of radically new and alternative service ideas and solutions. The approach can be understood as an interpretive practice that aims to make sense of the factors that influence the service system and process from the client's perspective [32]. Interpretation emphasises the relationships between different actors in the creation of value in a socio-material environment [17]. Indeed, the process often involves working on a vaguely defined problem whose solution cannot be rationally deduced; instead, the solution is sought and developed in collaboration with clients and stakeholders iteratively through several design cycles. Service design provides a framework, methodologies, and tools to involve different actors and support co-creation. The service experience should be consistent from the customer's perspective, which requires the organisation to integrate the different elements of the service to best meet the customer's objectives. Service design takes into account the service system as a whole, enabling the exploration of relationships and interactions within the service ecosystem. It can be used to further design and integrate elements of the service system, such as the physical environment, people, and service operations process, through which customers co-create value with the service provider [28;25]. Service design thus aims to ensure that service interfaces are useful, usable and desirable to the user, and efficient, effective and distinctive to the service provider.

Various process models for service design and design thinking have been presented in the literature, generally containing three to six steps (see e.g. Moritz, 2005; British Design Council, 2007; Dark Horse Innovation, 2016; Liedtka et al., 2017; Stickdorn et al., 2018). In essence, all models share a similar logic and mindset: research - analysis - development - implementation. Design processes are usually presented as a clear and chronologically progressive structure, but in practice they are by nature non-linear cycles. Each process model complements existing design methodologies, providing a design thinking perspective that can be integrated into service design and development processes in a way that is appropriate to the situation. In other words, different tools and methods can be used at each stage to achieve the desired outcome.

2.3 Towards a pedagogical approach that supports open learning and the partnership model

LbD is Laurea's pedagogical approach where learning takes place in real working life contexts through research and development. Learning is based on the acquisition of theoretical knowledge and its application in practice. Students, experts and partners (e.g. companies, municipalities and cities), citizens and consumers work together to create new knowledge and work on a project for the development of working life. The learner's competences are developed in dialogue with the knowledge-enriching community. The community is an environment of shared expertise, where the learner's role is to act as an expert, developer, and influencer. The resources for competence development are a learning culture that encourages creativity and purposefulness, expert teaching and guidance, and a learning environment that supports competence development. Every teacher is a mentor who, through his or her expertise and practices, supports the learner's development of expertise. The learning environment consists of a network of competences, an environment for innovation, a platform for the development of competences and structures to support learning. The starting points for development-based learning are investigative learning [13] and Dewey's pragmatism [8; 9; 10]. It is characterised by authenticity, partnership, experience, creativity, and exploration. The strengths of development-based learning have been identified as increasing students' independent thinking and self-confidence, working with real-life problems, getting in touch with companies and organisations early in their studies, and improving their employment prospects [27]. LbD model is a theoretical framework for work-based learning, but it does not provide conceptual tools or approaches

for the practical design and analysis of teaching and learning. Hakkarainen's and Paavola's trialogical learning framework and conceptual tools could be useful for the design and assessment of teaching and learning in EQF7-level service design education.

Hakkarainen and Paavola argue that in addition to the traditional metaphors of learning, which emphasise learning as (1) a process of knowledge acquisition by individual learners ('monological' approach) and (2) learners' participation in social interaction ('dialogical' approach), there is also a third approach. This "trialogical" approach refers to learning as a process of knowledge creation, focusing on mediated processes in which a common object of action is developed collaboratively. The monological, dialogical and trialogical approaches are based on three metaphors of learning, which approach learning as: a) knowledge acquisition, b) cultural participation and c) knowledge creation [14; 3]. Learning and human cognitive activity in the knowledge creation metaphor is not based on the mind of the individual or on communal practices per se, but on the interaction between the individual and the community through mediating artefacts produced by different people. The trialogical approach can be seen as a conscious and systematic co-creation and production of new knowledge. Trialogical learning refers to a form of collaborative learning in which activities are organised around the development of shared objects that are created and shaped together [23]. Shared objects can be very diverse, such as texts, models, plans, products, or services to be developed for customers.

Trialogical learning has been applied especially to the implementation of extensive and demanding study modules in higher education institutions. In these modules, students are tasked to take a lot of responsibility for organising the entire development process, its outcomes and keeping in contact with the client [24] as well as other stakeholders.

3 METHODOLOGY

A research strategy that aims to influence the subject and its activities by developing and improving them is called action research. In action research, influence is based on the research that the researcher conducts in the context of the research object and takes the form of the researcher's participation in the activities of the research object. The strategy of action research is therefore to simultaneously investigate and seek to change existing practices. The research is a collaborative search for solutions to identified challenges and the subjects, i.e., the people working in the research site, are actively involved in carrying out the action research. Action research is (a) intervention-based; (b) practice-based; (c) participatory; (d) reflective; (e) a social process that aims to study social reality in order to change it and to change reality in order to study it. Action research proceeds in a spiral with the following stages alternating (Figure 2.): Planning the action -> Implementing the action -> Observing the effects of the action -> Reflecting on the action [15]. Action research was chosen as the research strategy for this study because of its situational, collaborative, and participatory nature.

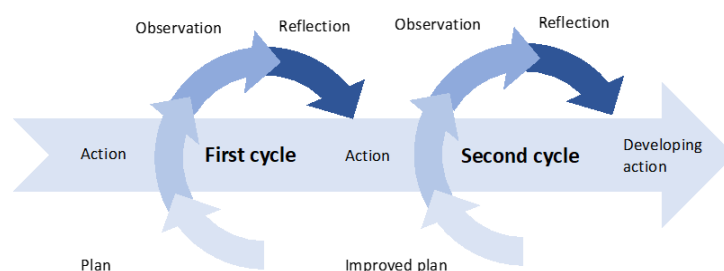


Figure 2. *Spiral of action research [15]*

This study will implement small-scale interventions in a real development context and study the impact of the interventions. The action research consists of three cycles and aims to innovate and develop models that link EQF7-level UAS education more closely with research and innovation activities, while strengthening the role of UAS as facilitators of co-creation and knowledge production processes in open innovation ecosystems.

3.1 First cycle of action research

The aim of the first cycle is to deepen the understanding of work-based project studies in EQF7 level service design education. Observational data was collected during two service design courses: Service Design Process and Methods (10 credits) and Agile Methods in Service Design (10 credits) in spring 2019. In the Service design process and methods course, the students worked on an

assignment for a Finnish wellbeing technology company. The task of the three-person, multidisciplinary student teams was to design a new digital service concept by utilising future and technology foresight data and to apply it and the user information they had acquired in their design work. In their work, the students applied a variety of service design methods and tools that support co-creation and the creation of a common understanding between users, designers, and the client. The Agile methods in service design course focused on the application of agile methods in the design of digital services. The students were asked to design a digital service concept for a business partner, a bank, to monitor and plan their own finances for consumer customers. During the course, the students developed and tested different design solutions iteratively and agile based on feedback from users.

Both courses were carried out in close collaboration with a business partner. The research material consists of observation data, lesson plans, teachers' notes, students' self-assessments, feedback from the client and verbal assessments of the lesson performance. In addition, students evaluated their own work-based project learning and business partners evaluated the effectiveness of the model from their perspective. Based on these two course implementations and the literature, a first version of a work-based project learning model suitable for EQF7 level service design education was created, which was applied, evaluated, and developed in the following course implementation.

3.2 Second cycle of action research

The second cycle of the action research focused on clarifying and defining the roles and tasks of the actors in the project-based learning model for EQF7-level service design learning. For this purpose, seven service design lecturers and senior lecturers were interviewed in autumn 2019. All of the interviewees had strong and diverse experience in implementing service design projects in their own courses. The interview material was analysed using content analysis methods. As a result, the roles and responsibilities of the different actors were refined to better support the planning and practical implementation of LbD pedagogy (Table 1). [16]. The updated pedagogical approach combining RDI activities and teaching was applied and further developed on the basis of the evaluation data in the following service design course implementations.

Table 1. The roles and responsibilities of different actors in the updated pedagogical approach

	1. Preliminary arrangements	2. Working on the commission	3. Implementing the project	4. Finishing the project
Teacher	<ul style="list-style-type: none"> Initial negotiations with a potential client Introduces study unit objectives/structure to the client Evaluates the applicability of a commission to the study unit (e.g. EQF7) Checks the suitability of commission to LbD Establishes frames for co-creation Defines a preliminary design brief (project assignment must leave room for creativity and service design process) Co-operation agreement with the client 	<ul style="list-style-type: none"> Ensures that the requirements of the study unit and EQF7 are fulfilled Discussions with client about task instructions/project assignment Informs students about client and study unit project (if possible/seen reasonable) Maps the expertise and domains of the students 	<ul style="list-style-type: none"> Presents the learning goals Creates a social atmosphere Helps students to get to know each other Supports cohesion in the design teams Guides the student towards purposeful work Guides students to the right level of work Inspires students to creative problemsolving Supports the learning process and helps with problemsolving Provides tasks that encourage interaction Keeps track of meeting the learning goals Follows and guides project process 	<ul style="list-style-type: none"> Responds to the commission together with the student team Evaluation (study unit qualifications, development processes and results) Offers feedback to the students and client Receives feedback from the commissioner Develops study unit according to feedback
Student	<ul style="list-style-type: none"> Adopts the idea of LbD Reflects their own expertise with respect to theory/materials of the study unit Studies theory of the study unit Plans own schedule for the study unit 	<ul style="list-style-type: none"> Students share their know-how and experiences in study group and team 	<ul style="list-style-type: none"> Team chooses the leader and roles Conceives of a project plan for the team Works to the schedule Solves the design challenge by implementing the plan in accordance with design process The team leader manages the schedule Works according to design process Student construe their learned knowledge 	<ul style="list-style-type: none"> Responds to the commission and presents the developed concept Receives feedback and adds finishing touches to the concept Peer reviews Submits the documentation for the development work Gives feedback to teacher

Client / Business partner	<ul style="list-style-type: none"> Participates in the initial negotiations to understand the learning goals of the project Defines preliminary objectives for design brief Makes co-operation agreement with Laurea 	<ul style="list-style-type: none"> Presents the demands for development in the organisation Modifies and defines the assignment Defines project resources such as task content, time and financial resources 	<ul style="list-style-type: none"> Presents design brief and design challenges Provides feedback about ideas/prototypes Encourager & co-learner Inspires students with good first impression Provides space as a learning environment Offers feedback and comments 	<ul style="list-style-type: none"> Participates in the presentation of development work Receives the finished works of student teams and documentations of the development process Offers feedback and comments on the finished work/process/collaboration
Support service	<ul style="list-style-type: none"> Searchers for clients and commissions Maintains connections with clients Manages contractual matters Contracts and signatures (e.g. IPR and NDA) Potential money transactions (e.g. administrating a cooperative) 	<ul style="list-style-type: none"> Reserves and allocates finances for the use of the project team Material and travelling expenses External outsourcing services Reserves the necessary working spaces and tools 	<ul style="list-style-type: none"> Allocates financial revenues for the use of the project team (e.g. through a cooperative) Material and travelling expenses External outsourcing services Technical support 	<ul style="list-style-type: none"> External communication Compiles statistics on RDI points

3.3 Third cycle of action research

The aim of the third cycle of the action research was first to ensure that the pedagogical approach combining RDI activities and teaching enables all three levels of learning and knowledge production: monological, dialogical and triological learning. For this purpose, the model was mirrored in Hakkarainen's and Paavola's framework for triological learning. In addition, students self-assessed their own work-based project learning and teachers self-assessed the developed work-based project learning model. Four Master's level students and seven teachers participated in the interviews. The analysis of the interview data was carried out using content analysis and inductive reasoning.

4 RESULTS

This study resulted in 1) a pedagogical model for EQF7-level service design studies that promotes the integration of RDI and teaching and 2) a course planning and assessment tool that uses three metaphors of learning. These are described in more detail in the next sub chapters. The results are further developed when integrating the REDISOTE (2022-2023) project into Master's level education.

4.1 A pedagogical model for combining education and RDI

Table 2. Pedagogical model for combining education and RDI activities

Stages in the service design process	Course objectives, competences to be acquired and participants in the phases
Collecting research data	<p>Objectives:</p> <ul style="list-style-type: none"> To understand the nature of the planning problem in context from the perspective of the different actors Identify new perspectives and opportunities in the planning problem Identify the nature of the problem, needs and opportunities Gather and build a rich and comprehensive knowledge resource <p>After completing this course, students will be able to:</p> <ul style="list-style-type: none"> Apply a service design approach to the innovation process Apply the service design process and methods to service design Evaluate the user experience at different stages of a service Promote creativity Work with users and stakeholders in creative service design projects Lead a service design project <p>Participants:</p> <ul style="list-style-type: none"> Citizens/customers/users, businesses, public sector, third sector and students

Analysis	Objectives: <ul style="list-style-type: none"> ● To analyse the qualitative and quantitative data collected in the previous phase ● To synthesise the findings into problem-solving themes of value to users ● To summarise and visualise a clear description of service needs from the perspective of users and stakeholders for ideation and design After completing this course, students will be able to: <ul style="list-style-type: none"> ● Analyse the qualitative and quantitative research data collected in the previous phase ● Identify latent user needs and the new opportunities they offer ● Design a holistic user experience at different stages of the service Participants: <ul style="list-style-type: none"> ● Citizens/customers/users, businesses, students
Development	Objectives: <ul style="list-style-type: none"> ● To draw up a plan for the introduction of the service ● To design in detail the service components as part of the users' activities and overall user experience ● Develop ideas and concepts iteratively with users and stakeholders After completing this course, students will be able to: <ul style="list-style-type: none"> ● Apply service design methods and tools in service design. ● Communicate, visualise and share service development ideas, objectives and processes. ● Evaluate design solutions together with users ● Develop design solutions iteratively based on user and stakeholder feedback Participants: <ul style="list-style-type: none"> ● Citizens/customers/users, businesses, public sector, third sector and students
Implementation	Objectives: <ul style="list-style-type: none"> ● To promote the publication of the service concept and the deployment of the service ● Design and implement appropriate feedback mechanisms ● To share the lessons learned from the design process with the different actors involved After completing this course, the student will be able to: <ul style="list-style-type: none"> ● Communicate the design solution to customers, users and stakeholders ● Reflect and evaluate their own learning process, the service design methods and tools they have applied and the results of their development work Participants: <ul style="list-style-type: none"> ● Students

The new pedagogical model developed in the context of service design (Table 2.) offers business partners/clients and citizens/customers the opportunity to participate in an open innovation process together with multidisciplinary teams of students, companies, public and third sector. The aim of the development work is not only to provide students with service design skills or to offer them a unique opportunity to participate in the development of a new culture of innovation, but also to serve the RDI project by using the students' multidisciplinary competences to enrich the research material and to find new perspectives for development activities. Every stage of the service design process, different objectives for both the development activities and the learning processes are defined, as well as the creation of value for the different actors are described.

4.2 A course planning and assessment tool using the three metaphors of learning

Table 3. Course planning and evaluation tool that utilizes the three metaphors of learning

	Monological learning	Dialogical learning	Triological learning
	<ul style="list-style-type: none"> ● Monological, i.e. mental perspective ● Learning through data acquisition ● Learning takes place in a person's mind that processes especially conceptual knowledge and concept structures ● The mind of an individual; individual expertise; ● information processing skills 	<ul style="list-style-type: none"> ● Dialogical, i.e. interaction perspective ● Learning through participation in culture ● Learning emphasizes communality and the process of growing into a community ● Communal practices, cultural information, operator networks 	<ul style="list-style-type: none"> ● Trialogical, i.e. developing mutual goals together ● Learning as knowledge creation ● The starting point of learning is not just a human's mind or communal practices in themselves, but the interaction between the individual and the community, which is seen to take place through intermediate artefacts produced by different people. Special focus is on processes in which something new is produced communally ● A conscious and systematic effort to develop socially shared objects (material or conceptual artefacts) in a communal way and to exceed prior learning

	<ul style="list-style-type: none"> ● Activity unit: Individuals 	<ul style="list-style-type: none"> ● Activity unit: Communities or individuals as a part of an operating environment 	<ul style="list-style-type: none"> ● Activity unit: Interaction between individuals and the community through artefacts and tools
1. Starting points for planning the learning exercise	<ul style="list-style-type: none"> ● Each student has competence based on their previously acquired educational background, which will be expanded 	<ul style="list-style-type: none"> ● Students are divided into multiprofessional design teams in which competence is shared 	<ul style="list-style-type: none"> ● Students are divided into multiprofessional design teams in which existing competence is shared and new knowledge is created through mutual development of shared objects
2. Defining the learning exercise	<ul style="list-style-type: none"> ● Students familiarize themselves with a planned project assignment and the sector in question independently ● Students deepen their knowledge by familiarizing themselves with the key concepts and theories of the study unit ● Students practice using methods and tools independently 	<ul style="list-style-type: none"> ● Students deepen their own understanding by working together and learning from each other, e.g. by discussing the key concepts and theories of the study unit together ● Students use boundary objects to communicate and form a shared understanding ● Student groups practice the use of methods and tools together 	<ul style="list-style-type: none"> ● Teachers, students and the client work together to complete the design challenge ● Multidisciplinary student groups define the objective of their own group work and make it a "socially shared target of development" for themselves ● Students from different backgrounds share and develop their competence and create new knowledge to achieve a shared goal
3. Completing the learning exercise	<ul style="list-style-type: none"> ● Students complement their skills as necessary; expertise of the field, concepts, theories, methods and tools 	<ul style="list-style-type: none"> ● The teacher guides the design team and the completion of the learning exercise ● Multidisciplinary teams share their competence to complete the learning exercise ● Teams use visualizations and prototypes to support discussion between the teacher and client (i.e. use boundary objects) 	<ul style="list-style-type: none"> ● Multidisciplinary design teams share and develop their expertise to achieve a "socially shared mutual target" ● Design teams create new information together with the teacher, client and other stakeholders ● Creating information and working on a mutual goal are completed in interaction with the social community through different tools
4. Assessment of the learning exercise	<ul style="list-style-type: none"> ● Students receive a grade based on the development of their competence 	<ul style="list-style-type: none"> ● Students receive a grade based on the development of their competence ● In addition, students peer review the results achieved by their own team and other teams 	<ul style="list-style-type: none"> ● Students reflect on the learning of their own group from the perspective of mutually defined learning objectives ● Students also peer review the results achieved by other teams

The three metaphors of learning provide a useful framework of reference and conceptual tools for planning and evaluating pedagogical solutions. The results of our study indicate that the learning process of an innovative knowledge community should consist of all pedagogical solutions that support the different metaphors of learning and that should already be considered during the planning phase of the course. The three metaphors of learning and the three approaches based on them help to build appropriately progressive learning modules and diverse learning experiences. We have developed a tool presented in the table above (Table 3) for the design and evaluation of pedagogical solutions of especially for courses and learning modules that are integrated with RDI activities. [18].

5 CONCLUSION AND DISCUSSION

Knowledge production processes are vital to the knowledge society and therefore at the heart of EU research and innovation policy. Hakkarainen and Paavola have examined the trialogical epistemology of innovative knowledge communities. By trialogic they refer to the organisation of such communities around socially shared common objects, the creation and development of which are the main purpose of these communities. The concept of innovative knowledge community seeks to model how something new is created and to address the challenge of how the community development of an object should be organised. For this reason, these concepts are particularly useful for developing higher education and for linking higher education and RDI activities. The systematic co-creation and production of new knowledge that is characteristic for trialogical learning promote to gaining the learning objectives of higher education.

The main contribution of this paper is a pedagogical model that is highly suited to integrating the three tasks of universities of applied sciences – education, R&D and regional development. In addition to their educational mission, higher education institutes promote regional development by maintaining networks and orchestrating innovation activities in the ecosystem. The results indicate that higher

education institutes have a significant role in the public innovation ecosystem as drivers of national competitiveness.

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