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NEW APPROACH AND TOOLS FOR SYSTEMATIC INTEGRATION OF HIGHER EDUCATION WITH RESEARCH AND DEVELOPMENT PROJECTS

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Abstract

The purpose of this study is to create a pedagogical approach and tools for systematic integration of higher education with research and development projects. The appeal and usefulness of education decreases if learning methods cannot stay abreast with the workplace challenges. Instead of just reacting to the changes in working life, the development of pedagogical approaches in higher education should be the path-setter for that change. The Master's degree education at the Universities of Applied Sciences (UAS) has a lot of potential as a creator new kinds of interaction models and multi-directional learning processes, because most of the students study while at work. UAS Master's students employed in expert and developer tasks in companies and public organizations are in a central position in the workplace development and transfer of knowledge between UAS and working life. The challenge has been a closer integration of UAS education with the research, development and innovation (RDI) activities of the UAS to ensure that the effectiveness of both the education and RDI activities would become stronger. This empirical paper is based on a three-year research and development project which goal has been to create a systematic approach and tools for the integration of higher education and RDI projects. The project started by a two-year future-oriented service design process that went through the phases of 1) understanding the contexts and needs of students, 2) ideating with the students and instructors, and 3) prototyping and rapid experiments of new methods and tools. The data generating methods used during this process include probes, interviews, and workshops with part-time Master degree students and their instructors. Almost 150 adult students, who study alongside their full-time job, were involved in the design process. After this service design process, the second phase of the project started in the beginning of 2016 and it still continues. The second phase has included the following steps: mapping the current status, analysis and creating the design drivers for the solution phase, ideation and rapid experiments, defining the integration model and key performance indicators, piloting, implementation, follow up and modifications if necessary. Rapid experiments during the three-year research and development project have enabled the creation of the pedagogical approach and several concrete tools for integrating the education and RDI projects. The approach, called Learning by Researching and Developing (LbRD), is a continuum to the pedagogical approach called Learning by Developing (LbD) where students are offered real working life experiences and projects during their studies. In addition to the novel approach, this paper introduces five tools supporting the systematic integration of higher education and RDI projects: the Visual information wall, Activity calendar, Project markets, Planning and Assessment template for Project Studies, and the New course "Research and development projects in the working life – how to get funding?". The new approach and tools demand courage but also inspire in everyday work and offer possibilities for collaborative learning, also for the educators and other UAS staff members.

Keywords: Learning and Teaching Methodologies, Pedagogical innovation, Higher education, Research and development, Learning by Developing.

1 INTRODUCTION

The context of this research and development project is the Master level education at Laurea University of Applied Sciences in Finland. Master's degrees at Universities of Applied Sciences (UAS) became standardized in Finland's system of higher education institutions in 2005. Over the past ten years, the nature of these degrees as adult education has become established and recognized [1]. In 2016, the milestone of 13,000 completed UAS Master's degrees has been achieved, and currently there are approximately 9,000 students studying a UAS Master's degree in Finland. In the eight-step European Qualification Framework (EQF) UAS Master's degrees are graded at the level seven – the same level with Master's level degrees of universities of science. Based on the dual model of higher education institutions in Finland, the profiles of these two Master's degrees are different. UAS Master's degrees emphasize research-oriented and innovating professional competences and workplace

development, while the emphasis of the Master's degrees of universities of science is on scientific and research skills. Already at the application stage, UAS Master's degree requires at least a three-year work experience after the applicant's latest degree. Thus, UAS Master's students represent working life and know about its daily challenges. As the majority of students study alongside their full-time work, the UAS Master's degree provides a good opportunity to combine competence growth with workplace development and with research, development and innovation (RDI) at the UAS. Typically, UAS Master's education cooperates innovatively with workplaces in a wide variety of contexts and networks. Innovative cooperation promoting workplace practice and business as well as people's well-being has constantly increased and developed its forms. UAS Master's students employed in expert and developer tasks in companies and public organizations are in a central position in the workplace development and transfer of knowledge between universities of applied sciences and working life [1].

Working life in the future is facing greater and greater challenges. New technological, social and business innovations will be needed to safeguard competitiveness and wellbeing. Rapidly changing global societal and transformative forces have led to major needs for changes in businesses and public sector and also in the higher education. Innovative workplace development requires interface skills in various educational fields. Innovation potential lies in interfaces; similarly the most critical problems of working life are hidden within these interfaces. Because the needs of workplace development generally do not follow the boundaries of science universities' areas of teaching and research, the working life orientation of UASs enables more flexible structures with which to make use of multi-disciplinarity and introduction of members from various areas of expertise [2]. The multidisciplinary of UAS student groups has not been fully utilized in workplace development or in RDI activities. The challenge for the future is to integrate UAS education more strongly into the university's RDI activities and other companies' service activities.

From the viewpoint of the UAS, RDI activities are often at their lightest when the student is doing a thesis for one's own workplace – this has been the most typical form of RDI in UAS Master's degrees [3]. Even though the theses of UAS Master's degree are oriented towards working life, they generally do not provide any wider impacts for workplace development. For example, the interfaces between different industries and competence fields are rarely brought under discussion. Due to this, also innovation potential is left unutilized. At its best, the RDI activities of the UAS can be regarded as a part of the onward development of UAS's own selected areas of expertise together with the region's companies and other organizations and as the production of new knowledge and competences related to that [3]. Networks forming on the interfaces of various industries, organizations and educational fields have a more and more important role and significance in the development of RDI activities, in the development of UAS Master's students' skills and transfer of that competence to working life. As far as future is concerned, the important question is how to more effectively combine the expectations of UAS Master's degree students and their work communities, the region's development needs and the RDI related interests of the UAS. Needs of working life and new forms of learning challenge us to construct cooperation environments between working life and education that genuinely promote multidisciplinary knowledge production, networking and communal learning and increase the effectiveness of education as well [4].

The purpose of this article is to create a pedagogical approach and tools for systematic integration of higher education with research and development projects. Next, the backgrounds for integration of higher education with research and development are briefly introduced. Then, the stages of the empirical research and development project are described. After the process description, the results are shown. Lastly, the conclusions are made.

2 INTEGRATION OF HIGHER EDUCATION WITH RESEARCH AND DEVELOPMENT ACTIVITIES

Working life demands skills and abilities to apply knowledge and act and manage situations in the changing working environment. The pedagogical model, Learning by Developing (LbD), created and implemented at Laurea University of Applied Sciences, responds to the needs of working life. The LbD model is a pragmatic learning concept where learning is seen as a tool for producing new practices of action through continuous interaction between people and the environment. Collaboration and activities that change individuals and the environment in addition to the role of experiences and interaction are emphasized in the LbD learning model where learning is active and consists of restructuring and building experiences and handling new situations [6].

In the constructivism pedagogy, learning is considered as the creation of new knowledge. Additionally, an action oriented, pragmatic learning concept identifies learning as a tool with the purpose of formation of habits of action. In the pragmatic learning concept, knowledge is linked to the ways of action that helps in getting along with the changing world. Development projects are seen as a learning environment which enable the formation of new habits of actions with the cooperation among students, teachers, workplace experts and clients. The Learning by Developing model integrates competence-producing learning and working life projects offering new learning possibilities. In a project, students learn to recognize the areas of development, create new solutions, products and action models, and develop their activities, while taking into account the changing requirements of the employment sector. The pedagogical model consists of following parts: 1) identifying the phenomenon of the development project, 2) reflecting on the meanings of earlier research findings and solutions, 3) predictive identification and description of processes related to the project, which enables both an initial presumption based on facts and discoveries and a personal curriculum, 4) collaboration, which includes the creation of new habits of action and problem-solving skills, 5) continuous evaluation of the project and personal learning process (consequences of activities), 6) sharing experiences and creating new meanings, 7) recognizing and evaluating achieved competence, 8) assessing the impact of the project, and 9) sharing, disseminating and producing the outcomes. [6, 7].

The Learning by Developing (LbD) model offers a deep understanding about multi-disciplinary and multi-professional skills in addition to the ecosystem where students, professionals and teachers learn together in working life. The model enables a connection to working life with whom the joint development work is executed. Instructors are seen as facilitators, and working life representatives and students participate to the projects as partners. The LbD model is a strategic choice, which integrates Laurea UAS's regional development task, research, development and innovation projects, and teaching. It has been developed in a collaboration with Laurea UAS's instructors and students and representatives of working life. The holistic model of competence was applied as the framework for Laurea UAS's pedagogical strategy where learning environment was seen as an enabler for the development of new activities. Laurea UAS's responsibility of regional development lead to the importance of authentic working life projects during the studies [6, 7, 8].

Cheetham and Chivers [9] have developed a holistic model of professional competence as a framework with five aspects: cognitive competence, functional competence, personal competence, ethical competences and meta-competences. According to Raji [10], the holistic model of professional competence was identified as an integration of knowing, understanding as well as acting and situation management. In terms of the knowledge, the model is seen as an integrated whole that links 1) knowledge written in theories and models, 2) knowledge integrated in skills and abilities, 3) moral knowledge and 4) experiential knowledge. The model shows an action based approach.

3 RESEARCH AND DEVELOPMENT PROCESS

This empirical paper is based on a three-year research and development project the goal of which has been to create a systematic approach and tools for the integration of higher education with RDI projects. The project started by a two-year future-oriented service design process that went through the phases of 1) understanding the contexts and needs of students and other stakeholders, 2) ideating with the students and instructors, and 3) prototyping and rapid testing of new methods and tools.. With choosing service design as the leading approach in this research and development project, the aim was to genuinely create new solutions from the students' viewpoint, i.e. get students and staff members tightly involved in all the stages of the development work. That is an essential characteristic of service design: all development is based on profound and empathic understanding of needs, wishes and contexts of service users and other stakeholders [11]. Various methods can be used to get the deep understanding: people are made tell about issues, their actions and contexts are observed, and they are involved in the creation of new ideas with the methods of co-creation [12]. In this project, the users of the education service, that is students, were integrated in the development project: almost 150 Master's degree students have taken part in the project as researchers, developers, or participants in interviews, probe studies and ideation workshops.

The first phase of the service design process aims at the acquisition of deep customer understanding [12]. At this phase, the emphasis is on emphatic methods, with the help of which a profound understanding of people's daily life, behavior, values and hidden needs are gathered. Typically, the methods are contextual which means that for example interviews are conducted in genuine service environments [13]. Probes are used for the observation of daily life, i.e. a self-documentation device for the target of investigation to fill in materials, typically various kinds of diaries given to participants,

in accordance with the tasks given. Probes are useful for example when researchers are not able to make observations of the target group in its own environment or when observation data is needed to cover the entire day [14].

In this research and development project, altogether 19 Master's degree students were given probes, i.e. diaries designed for this project with which students documented their daily life at home and at work. Then, they and 16 other Master's degree students' were interviewed - the total number of student interviews was 35. In the interviews, the diaries filled in by the students and photos of everyday life taken by them were used as discussion aids. In addition, six Master's degree program instructors were interviewed. Through their student tutoring experience, they had some idea about students' everyday life, challenges and goals. The instructors were also asked to tell about their experience on integration of Master's degree studies with different RDI projects. Collection and analysis of interview data was carried out by five Master's degree students, of whom three did a learning exercise for the service design study unit and two worked on their theses. The collected data were analyzed and compiled into eight student personas representing different education fields. Typically, personas are fictitious profiles of a person that are based on collected data. Usually a visual description of the imaginary customer is made: he/she will be given a name, age, face (a drawing or a photo), background details, behavior model, motivation for actions and other things that help in understanding the customer's daily life and value forming [15]. The personas created in this project describe everyday life of a typical student at home, at work and at study and his/her needs, behavior, habits, attitudes, and learning style. In service design, customer personas are a valuable tool, with the help of which customer-focused service ideas can be generated [16]. Concrete customer profiles also help in communications: with their help, all who participate in the development of the service will get a common idea about the behavior and needs of the customer group for whom the service is being directed [16]. The student personas created in this project have been used, among other things, as stimuli at the second stage of the service design, which has mainly consisted of various ideation workshops.

After the acquisition of deep customer understanding, typically creativity and sense of community are emphasized at the second stage of service design process [12]. Based on the gathered knowledge and understanding, new solutions are brainstormed as openly as possible. At this second phase of the service design process, different ideation workshops, design games and other methods are utilized, in which typically many kinds of stakeholders are included. In this project, two Master's degree students planned and managed two ideation workshops for several Master's degree students and alumni from different degree programs. In these, the CoCo Cosmos service design game developed in Laurea was used [17]. Lead by a Master's degree student, ideation workshops were arranged also for all Laurea UAS's Master's degree program instructors. Also, workshops where students, alumni, workplace representatives and Laurea UAS's staff ideated together were organized. In addition, during the action research course, 14 information systems students participated in a day-long future workshop. For that, they had taken photos of their daily life where they exchanged ideas about new models for the integration of Master's degree education with RDI projects.

After the ideation phase, at the third phase of the service design process, service design usually emphasizes fast modelling and testing of the service under development [12]. The service is made more concrete by visualizing it by different means, by building prototypes of the service, or by simulation, that is, by creating experimental situations. Concretization of an immaterial service into various experimental models makes it possible to include various parties, for example customers and employees, into testing. This quickly reveals whether a functional and desirable service is under development. If so required, the development work can be redirected without wasting time and other resources to something planned in too much detail too early [13]. In this project, various rapid experiments were carried out from the outset. The tools that will be described in the next section are all results of the rapid experiments done during the process.

After this two-year service design process, the second stage of the development project started in the beginning of 2016 and it still continues. The second stage has included the following steps: mapping the current status, analysis and creating the design drivers for the solution phase, ideation and rapid experiments, defining the integration model and key performance indicators, piloting, implementation, follow up and modifications if necessary. When mapping the current status the results of the previously mentioned future-oriented service design process were studied as a part of the desk-research. In addition six expert interviews were carried out and one discussion was held with process owner of regional services and a project planner of RDI unit of Laurea. To get more profound view of the current practicalities and their implications, two workshops were organized. The participants of the

workshops were lecturers, project managers, project planners and other staff members. The results were used to create the design drivers for the solution phase of the process and inspire the ideation. Two ideation workshops were organized, again with the participants representing the similar roles than before. Parallel to the workshops several rapid experiments were implemented and even some iteration rounds were made. After the ideation and experiments the fourth workshop focused on testing the prototype of the integration model. All together over 100 staff members participated to the development process. Along the process there has been four (the fifth is still coming) steering group meetings with the top management and the activities were reported to the management board of Laurea on monthly basis. At a moment the integration model is finalized and KPIs are defined. The piloting and partly the actual implementation starts during the current academic semester.

4 RESULTS OF THE DEVELOPMENT PROCESS

In this section, the five tools for integrating education with RDI projects, created based on this study, are briefly described. They are 1) visual information board, 2) activity calendar, 3) project markets, 4) planning and assessment template for project studies and 5) a new Master level course. Three first ones are planned for the staff, the fourth both for the staff and the students and the last one for the students.

4.1 Visual information board

Visual information board is a tool for project management. When developed further during the development process it also serves the integration of education and RDI projects. Visual information board is located in Laurea UAS's RDI department's open working space. On the board, all the projects are illustrated in a card, including basic information about the project, their phase from idea preparation to project implementation (or proposal's rejection). At first the basic information included the name of the project, the call from which the funding is applied, the name of the person who is in charge of the preparation of the project proposal and funding decision date. The information on the board allows an easy and quick overview and understanding of RDI projects that are planned or currently active. Idea from management point of view is to optimize flow of different activities and to provide simpler information and eliminate waste e.g. combine resources when possible and avoid overlapping work.

After trial phase, there has been several additions to the visual board, and based on rapid experiments, solutions have been developed further. In order to improve the integration of RDI projects with higher education, new information was added to the project cards. Also, information about Master's degree programmes, their contents and personnel were added as separate cards on the board. This has helped the communication between the actors and increased information flow and consequently also integration between education and RDI. Visual form of information makes it easy to identify the projects where integration is already planned and where this possibility still exists.

4.2 Activity calendar

Activity calendar is a list of activities scheduled to a one-year period. At first, the calendar was planned to serve Laurea UAS's RDI department in general. From there calendar has been developed to support the systematic integration of higher education with RDI projects. Time slots have been added when project managers and teachers should identify the needs and possibilities to plan and implement projects in integration with education. You can see when the teachers know the courses they will be in charge next academic semester, when the projects are presented in project markets etc. Activity calendar reminds both parties to act on time: promote the projects for integration to the teachers in charge of the courses and/or promote the courses to the project managers for integration.

4.3 Project markets

In the project markets, planned and ongoing projects are marketed to master's degree students in order to get the students involved in RDI activities. It is a new concept that has been held now twice in this format. Master level students participate to the event and the planned and ongoing projects are presented to them. Preparation of the event includes fulfilling the project description template, in which the competences needed and possible tasks are explained. The templates are published before the event in the student intranet to increase the probability of successful meetings. Besides students, also instructors are in the target audience. From the project markets, students can find a project which is in

line with their personal learning objectives and can work as an interesting learning environment for them. From the point of view of instructors, the event helps them to find a cooperation project for the studies they are responsible for. It is usually project manager's task to attend in project markets and plan what project in question is seeking from students.

4.4 Planning and Assessment template for Project Studies

Based on the prior experience and results of the current status analysis during the development process, it was evident that a specific tool was needed for the planning and assessment of project studies. After benchmarking the different templates in use, a new template was created which includes both the planning and assessment aspects. The template guides the project manager, instructor and student to discuss and agree all the relevant issues in order to achieve the objectives of the student (learning) and the project. The fields of the template are as follows: the name of the student, the name of the instructor, project identification, student's learning objectives (level EQF7), the tasks, responsibilities and schedule for the student, extent of the project studies planned (ects), theoretical knowledge base for the project work, outcomes, student's self-assessment, instructor's assessment, grade, the final extent of the project studies (ects), the title of the project studies for the transcript of records and signatures.

4.5 New course "Research and development projects in real life – how to get funding?"

Additionally a new course has been developed where students get the possibility to become a part of the team which prepares project proposals. The course "Research and development projects in real life – how to get funding?" was realized first time in spring/summer 2016. It was a new way to increase students' knowledge of possibilities offered by external funding in RDI activities. From Laurea UAS's point of view it was interesting to involve students, their ideas and their background organizations in project preparation and funding proposal preparation activities. Participating students represented a wide variety of degrees which also created interesting buzz in the course. The key persons responsible for the course were experienced in project preparation but there was a visiting lecturer in every lecture giving introduction to a different aspect of RDI project preparation and management from budgeting to vision of innovation in the European Union. In general RDI personnel were really interested in presenting their expertise area for students and that also led to positive feedback from students.

During the course, students were introduced to many possibilities offered by national and international research funding instruments. Course offered also information about normal project preparation management including project budgeting, how to prepare project consortium and how to design and write the project plan. Project management skills were also on the agenda even though emphasis was on project preparation and idea development. Much of the emphasis was actually on idea development. As a pre-course task students were asked to present their own or their organizations' idea for RDI project. For participating students the course offered different kind of possibilities to do collaboration between Laurea and students as they are usually working for organization that can become a partner in research project with Laurea UAS. There is already one example of this cooperation in practice. During the course a student prepared funding proposal for her organization according lectured guidelines and Laurea UAS became partner in the proposal. Proposal was successfully evaluated and eventually funded. This project starts early 2017.

Experiments described above are examples from Laurea UAS's new approach and tools for systematic integration of higher education with research and development projects. The integration of higher education and RDI activities blends into the role of higher education institutes where a pragmatic learning theory offers a basis for the development of higher education.

5 CONCLUSIONS

The pedagogical approach Learning by Researching and Developing (LbRD) is a continuum to Laurea UAS's Learning by Developing (LbD) model where students are offered real working life experiences while cooperating with existing working life projects during their studies. In the LbRD, students get possibilities to develop their skills in real RDI projects to apply knowledge and abilities to think in a logical, intuitive and creative way. In addition, they learn to use various RDI methods, materials and tools in order to find new kinds of solutions based on research. The LbRD approach offers a unique

learning environment for students: They can develop their skills and apply science in the RDI projects in a way which offers students different kinds of learning possibilities and takes their previous working and studying experience into the consideration. In the new pedagogical approach LbRD, the scientific approach and research process tend to be connected to the learning process more effectively than in the LbD model.

Based on the results of this study, it is fruitful to continue to develop the integration of education and RDI projects. Laurea UAS has recently launched a new study programme for Master degree students where all the courses will be implemented in ongoing RDI projects or project preparation processes. Instructors involved to this study programme are creating new pedagogical solutions to the RDI related projects where project tasks and theoretical perspectives need to be evaluated to correspond the learning objectives at the EQF7 level [5]. Principally students conduct their studies in projects which relates to their degrees, e.g. students studying in Master of Business Administration participate in the projects where they can practice the skills relevant in their studies. All the studies will be implemented in projects in a way that practice oriented tasks and scientific approach are combined in the LbRD method. In terms of workload, one credit corresponds to the 27 hours of work by the student. Master degree students learn to recognize areas of development in projects they participate in, they learn to create new solutions, products and action models and so on they have possibility develop their skills and knowledge, while taking into account the changing requirements of the employment sector. Scientific approach is related to all the actions through the literature related to the topic. The student's role in RDI projects is equal with other team members who reports tasks to the project manager and to the others members in the project. All the tasks will be planned and evaluated together with project members who are specialized in the pedagogical approach. Planning and Assessment template for Project Studies offer the basic for all the tasks and transferring them to ects credits.

In the near future, the pedagogical approach Learning by Researching and Developing and its effects to learning and students' study processes will be researched by qualitative interviews. The influence of the Learning by Researching and Developing approach in the Master degree students' learning processes and experiences and development of their competences will be researched by interviews carried out at the beginning of studies and after couple of years students have finished their studies. Ongoing development and research processes help Laurea UAS to evaluate its new approaches and tools for systematic integration of higher education and RDI projects.

The Learning by Researching and Developing approach integrates higher education and RDI projects and offers useful tools for integration. Most importantly, the main aim in Learning by Research and Development approach is to offer new kinds of learning opportunities to students.

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