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Students' perception of learning innovation competences in activity-based learning environment

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Abstract

This article demonstrates an example of activity-based pedagogy in university–company cooperation and shows whether these learning environments support students' learning of innovation competences. In this case study, students of a university of applied sciences were selected from three required undergraduate courses (15 ECTS). The students were from different engineering degree programmes and study years (n=77). In all courses, the learning was based on active learning methods under the concept of innovation pedagogy. According to the results of the self-assessment questionnaire, the students assessed that they had learnt innovation competences in their courses. Two groups of learners were found by K-means clustering. Chi square tests showed that all students are able to learn innovation competences. Gender, study year, work experience, or course were not associated with the learning outcomes of innovation competences. T-tests showed that students' motivation, importance of learn-

ing, atmosphere of the course, learning of field-specific contents and project-based learning preference are related to the learning of innovation competences. When designing learning environments and courses, more focus should be placed on creating a safe and supportive atmosphere, and on increasing students' motivation. This article is especially useful for those who want to train innovators and develop higher educational practices to embody the requirements of working life.

Keywords: *innovation competence, activity-based learning, higher education pedagogy*

Tiivistelmä

Artikkelissa esitellään esimerkki toimintalähtöisestä pedagogiikasta korkeakoulu-yritysyhteistyössä ja tutkitaan, tukevatko tämän kaltaiset oppimisympäristöt innovaatiokompetenssien oppimista. Tapaustutkimukseen valittiin erään ammattikorkeakoulun opiskelijoita kolmelta pakolliselta opintojaksolta (15 opintopistettä). Opiskelijat olivat eri insinöörikoulutusohjelmista ja eri vuosikursseilta (*n*=77). Kaikilla opintojaksoilla oppiminen perustui toimintalähtöisiin oppimismenetelmiin ja opintojaksot toteutettiin innovaatiopedagogiikan mukaisesti. Itsearviointikyselyn tulosten mukaan opiskelijat arvioivat oppineensa innovaatiokompetensseja näillä opintojaksoilla. K-klusterianalyysin perusteella löydettiin kaksi oppijaryhmää: enemmän ja vähemmän innovaatiokompetensseja oppineet. Khiin neliö -testi osoitti, että kaikki opiskelijat ovat kykeneviä oppimaan innovaatiokompetensseja. Sukupuoli, vuosikurssi, työkokemus tai opintojakso eivät ole yhteydessä innovaatiokompetenssien oppimiseen. Sen sijaan t-testi osoitti, että opiskelijoiden motivaatio, oppimisen tärkeys, opintojakson ilmapiiri, alakohtainen tiedollinen oppiminen ja projektimuotoinen oppimismieltymys ovat yhteydessä näiden taitojen oppimiseen. Oppimisympäristöjen ja opintojaksojen suunnittelussa tulisikin kiinnittää enemmän huomiota siihen, miten luoda turvallinen ja kannustava ilmapiiri sekä kasvattaa opiskelijoiden motivaatiota. Tämä artikkeli on hyödyllinen etenkin niille, jotka haluavat kouluttaa innovaattoreita ja kehittää korkeakoulukäytänteitä vastamaan paremmin tämän päivän työelämän vaatimuksiin.

Avainsanat: *innovaatiokompetenssi, toimintalähtöinen oppiminen, korkeakoulupedagogiikka*

Introduction

All sectors of the economy emphasise the importance of innovations. There is an urgent need for future professionals who can contribute to the creation of innovations, and higher education has a critical role (Välimaa & Hoffman, 2008; Vila, Perez, & Morillas, 2012). Higher education both educates undergraduates for their profession and trains future employees who are capable of generating innovations.

Although higher education has a central role in the development of innovation skills, studies have shown that these institutions have not met the demand. Educational practices have been criticised for not developing these prerequisites of professional expertise (e.g. Badcock, Pattison, & Harris, 2010; Quintana, Mora, Pérez, & Vila, 2016). Traditional forms of

university teaching, like reading, lecturing, and working alone, have even shown to be negatively associated with learning of the needed competencies (Vila et al., 2012; Virtanen & Tynjälä, 2016). Therefore, there is a growing call to base educational decision making on high-quality educational research and pedagogical practices generating needed competences (Michael, 2006).

This article offers an example of educational practice supporting students' professional expertise and shows whether that kind of learning environment supports students' learning of innovation competences. The article also studies whether there are differences in learning and what kind of factors are associated with the acquisition of innovation competences. This empirical case study is based on data from a Finnish university of applied sciences where university-company cooperation has been chosen as a context to research learning of innovation competences. The theoretical background of this study is based on activity-based learning and innovation pedagogy. This article explains how to create effective learning environments in higher education. The article is especially useful for those who want to train future innovators and to develop pedagogical practices to embody the requirements of working life. After the framework of theoretical background is introduced, the research context, data, and methodology of the study are described. Finally, the results of the study are presented, discussed and summarised.

Theoretical background

Towards active and meaningful learning

The emergence of the new field of know-how and requirements for education have resulted in a growing awareness of alternative theories of learning. These theories identify problems in traditional teacher-centred teaching and are often based on the principles of constructivist learning. Based on these theories, "learning is achieved by the active construction of knowledge supported by various perspectives within meaningful contexts" (Oliver, 2001, 5). Social interactions are also considered important to the processes of learning and cognition. In these approaches, the emphasis is on learning *how*, instead of learning *about.* (Michael, 2006; Oliver, 2001.)

Activity-based learning consists of different processes of keeping students mentally and often physically engaged in their learning (Michael, 2006). Traditional learning environments, such as classrooms, do not necessarily encourage engaged learning; finding answers and memorizing facts do little to inspire a passion to learn (Thomas & Brown, 2011). To achieve meaningful and deep learning, the focus should be on the learning from effortful practice and lived experience where students can revisit ideas, ponder them, try them out, play with them, and use them (Kettunen, 2011; Levine & Guy, 2007). Kivunja (2014) states that the key to teaching creativity and innovation skills lies in creating quality learning environments in which learners can solve authentic, real-world problems, and be inquisitive and open-minded. Vila et al. (2012) show that collaborating on solu-

tions to new problems improves the acquisition of innovation capabilities in higher education students. Activity-based learning theory provides a framework for that. Activity-based learning methods enable students to develop higher-order thinking skills through applied problem-solving and to master essential concepts using 'real world' problems as a context. Earlier studies have shown that activity-based learning methods not only enrich the contact sessions, but also improve students' chances to excel in the workplace. These methods have been shown to improve, for example, critical thinking, communication skills, argumentative, responsibility, and innovative abilities. (Henrico, 2012; Levine & Guy, 2007; Michael, 2006.)

Exploiting activity-based learning methods in innovation pedagogy

Under increasing pressure, universities have started to develop different pedagogical strategies and practices to match better for the future needs and develop students' working life skills (Nykänen & Tynjälä, 2012). Although working life skills are widely cited in pedagogical strategies (Nurmi & Mahlamäki-Kultanen, 2015), little attention has been paid to innovation competences. In innovation pedagogy, a model to redevelop pedagogy in higher education institutions, innovation competences are functionally integrated in learning systems designs from the beginning of students' studies. Innovation pedagogy is a strategic choice which permeates the entire organization and its activities, and supports the development of students' competences to participate in the processes of creating innovations. (Penttilä, 2016.)

Competence is a holistic concept, which describes person's ability to manage in a specific context (Mulder, 2012, 36). According to Marin-Garcia, Pérez-Peñalver, and Watts (2013, 49), competences, capacities and skills can be considered as the three categories of complexity in contextualized know-how. A competence is formed by a set of capacities, and these, in turn, are formed by a number of skills, all of which are prerequisites for a more and more complex professional performance. Competence could be described as complex know-how regarding how to act through the effective mobilization and combination of variety of internal and external resources within a set of situations. (Marin-Garcia et al., 2013, 49.)

In innovation pedagogy both study programme specific competences and innovation competences represent a new sphere of expertise. Therefore, innovation pedagogy emphasises dialogue among the educational organization, students, the workplace and society. The learning environments enable the application of theory to practice and emulating working life. It aims to narrow the gap between the demand for professional skills and the skills that students acquired in the classroom. (Kairisto-Mertanen, Penttilä, & Nuotio, 2011; Kairisto-Mertanen, Räsänen, Lehtonen, & Lappalainen, 2012.) Like activity-based learning theory, the pedagogical roots of innovation pedagogy can be found e.g. in constructivism, pragmatism, collaborative learning, and learning from experience (Kettunen, 2011).

Learning innovation competences in university-company cooperation

Employees who participate in innovative activities at the workplace are expected to have acquired specific skills and competencies during their studies (Kivunja,

2014; Quintana et al., 2016; Vila et al., 2012). Quintana et al. (2016) emphasise the need for cooperation between universities and companies in order to adapt teaching and learning processes to society's changing needs. Such cooperation can make higher education more effective, and has shown to improve the innovative capacity of the productive sector and, hence, promote economic growth and sustainability. It also provides several benefits for all stakeholders. The collaboration involves students in innovative activities, and their teachers have didactic model to enrich contact lessons. The company gains access to potential employees and the chance to form contact networks with academics for future collaborative research. Due to this, researchers and policy makers in Europe have been attentive to the relevance of university-business cooperation. Rossano, Meerman, Kesting and Baaken (2016) have studied students' learning in university-business cooperation with problem-based learning. They found that these learning environments give students an experiential and contextualized understanding of theoretical concepts. The opportunity to acquire practical experience in a real-life project and to develop actionable concepts in practice were the main incentives for students to participate in and also benefit from university-company cooperation.

Although many studies highlight the benefits for university-company cooperation emphasising the prevalence of proactive teaching and learning styles that instill capacities required to lead innovation, insufficient research has addressed the effects of such cooperation on education and learning from the students' perspective (Rossano et al., 2016, 40). Moreover, research on students' learning of innovation competences has received less attention (e.g. Bjornali & Støren, 2012; Kasule, Wesselink, Noroozi, & Mulder, 2015; Vila et al., 2012). This study responds to the lack of research on the topic, and discovers the relation of the factors to students' learning of innovation competences. The factors e.g. motivation, atmosphere and guidance are highlighted in theoretical bases of innovation pedagogy and activity-based learning, and previous studies suggest that these factors are related to the learning of similar attributes to innovation competences (e.g. Rossano et al., 2016; Virtanen, Tynjälä, & Eteläpelto, 2014; Virtanen & Tynjälä, 2016).

Data and Methodology

This study uses a novel assessment tool to measure students' innovation competences in the authentic learning environment of university-company cooperation. The tool has been developed in Framework for Innovation Competencies Development and Assessment (FINCODA) project (2015-2017) funded by the European Union. The purpose of the project is to modernise the assessment of learning outcomes, especially in relation to innovation competences in higher education institutions and companies. The tool is based on a literature review and a psychometric validation with mixed-method design including construct validity and criterion validity studies (Butter & van Beest, 2017; Marin-Garcia et al., 2016). The novel tool covers the lacks and limitations of earlier studies of innovation competence assessment (e.g. Marin-Garcia et al., 2013; Keinänen, Ursin, & Nissinen, 2017; Pérez-Peñalver, Aznar-Mas, & Watts, 2012; Watts, Marin-Garcia, Carbonell, & Aznar-Mas, 2012) which are only based on the higher educational context and data of students´ self-assessments. The psychometric properties of the assessments were either

not explicitly addressed.

The novel tool expands valid assessment of person's innovative behaviour into business and education. The tool was developed in cooperation with companies and higher educational institutions where an extensive psychometric validation study was conducted on a combined set of student data and worker data. Butter and van Beest (2017) show that the assessment tool has an adequate reliability and validity. They also show that there are reasonable correlations between the self-assessment scores and external indicators of innovation capacity, such as supervisor ratings of innovative behaviour and real-life examples of innovative behaviour. (see Butter & Van Beest, 2017.)

Based on the validation studies (Butter & van Beest, 2017; Marin-Garcia et al., 2016), innovation competences comprise five dimensions: 1) creativity, 2) critical thinking, 3) teamwork, 4) initiative, and 5) networking, which are operationalized for 34 items describing a behaviour or action needed in different phases of innovation processes. Definitions of the five dimensions are:

- Creativity: ability to think beyond existing ideas, rules, patterns or relationships. To generate or adapt meaningful alternatives, ideas, products, methods or services regardless of possible practicality and future added value.
- Critical thinking: ability to analyse and evaluate advantages and disadvantages and estimate the risks involved for a purpose.
- Initiative: ability to influence/make decisions that foster positive changes.To influence creative people and those who have to implement the ideas.
- Teamwork: ability to work effectively with others in a group.
- Networking: ability to involve external/outside stakeholders outside the team. (Marin-Garcia et al., 2016.)

The aim of this study is to research the five dimensions of innovation competences in higher education. The research questions are the following:

1. What kinds of innovation competences do students learn during their courses?
2. Are there different groups of students based on their learning of innovation competences?
3. Are gender, study year, work experience, course, motivation, importance of learning, atmosphere of the course, learning of field-specific contents, project-based learning preference, and support and guidance related to the learning of innovation competences in different groups?

This study applies a case study approach which seeks evidence in the case setting (Gillham, 2000). Students of a university of applied sciences (N=90) were selected from three mandatory undergraduate courses (15 ECTS). The respondents (n=77) were from different engineering degree programmes and study years. Most of the respondents were second-year students, 51.90% (n=40), and third-year students, 33.80% (n=26); the rest, 14.30% (n=11) were first- and fourth-year students. Most of the respondents were male, 82% (n=63), and 18% (n=14) were female. The criteria for selected courses were that all the courses are similar in extension, carried out in university-com-

pany cooperation during autumn semester of 2016, and implemented by different lecturers. Although courses differed in their content, the framework for all courses was innovation pedagogy and the studying was based on activity-based learning methods where students worked with authentic problem-based assignments, and innovated solutions for the companies. The contact lessons combined e.g. theory, working with the assignments, learning in teams and different active learning methods that supported the performing of the development assignment.

At the end of the courses, students completed a self-assessment questionnaire with 34 items of innovation competences. Respondents assessed their learning of innovation competences during the course on a 5-point scale: *1 = Very poor, 2 = Need to improve, 3 = Pass, 4 = Good, and 5 = Excellent*. Additionally, the questionnaire includes categorical variables of gender, study year, work experience and course. Moreover, it comprises single variables of motivation (*I have been motivated to perform the course*.), importance of learning (*It has been important to me to learn as much as possible during the course*.), atmosphere (*The atmosphere of the course has been encouraging and safe and it has encouraged discussion*.), learning of field-specific contents (*During the course I have learnt contents related to my study field, such as field-specific information*.), project-based learning preference *(I learn better in project-based learning courses than in traditional teacher-centred courses, such as lectures*.), and support and guidance (*I have received sufficient support and guidance in the course*.). The single variables were scored along a 5-point Likert scale, where 1 = *Completely disagree* and *5 = Completely agree*.

Based on the previous validation studies (Butter & van Beest, 2017; Marin-Garcia et al., 2016), five sums scales were created of the 34 variables on innovation competences (Table 1).

K-means cluster analysis was conducted to explore different groups of students based on their learning of the five innovation competences. The variables were not standardised since the units and scales of the variables do not differ (Gore Jr., 2000). Independent samples t-tests were used to compare two independent samples. For categorical variables, Chi-Square analysis was conducted as a test of association. (Lowry, 2014.)

Results

The first objective of the study was to determine whether and to what extent students have learnt innovation competences. The students assessed that during the courses they had learnt innovation competences, especially creativity, critical thinking, and teamwork (Table 2).

The second aim of the study was to explore whether there are different groups of students based on their learning of innovation competences. K-Means cluster analysis was conducted, and the analysis showed two clusters of students (Figure 1), confirmed by an ANOVA test (df = 75, Creativity $F = 45.40$, $p < .001$, Critical thinking $F = 43.89$, $p < .001$, Initiative $F = 55.00$, $p < .001$, Teamwork $F = 49.57$, $p < .001$, Networking $F = 80.88$, $p < .001$). The first cluster consists of students who report having learnt less all five innovation competences. The second cluster comprises students who report having learnt more all five innovation competences.

Table 1. Sum scales of innovation competences

Sum scale	Cronbach's alpha	Number of items	An example of an item
Creativity	.83	9	I generate original solutions for problems or to opportunities
Critical thinking	.70	6	I face the task from different points of view
Initiative	.76	6	I systematically introduce new ideas into work practices
Teamwork	.75	7	I invite feedback and comments
Networking	.81	6	I build relationships outside the team/organization

Table 2. Means and standard deviations of students' assessed learning of the five innovation competences

	M	SD
Creativity	3.63	.49
Critical thinking	3.64	.51
Initiative	3.33	.57
Teamwork	3.66	.48
Networking	3.33	.64

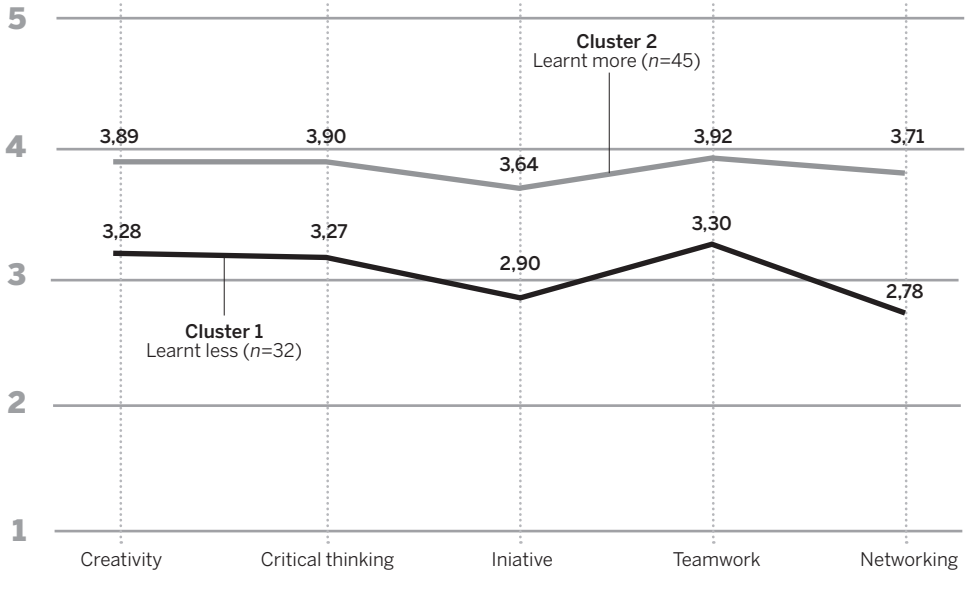

Figure 1. Two groups of students based on the assessed learning of innovation competences

The third aim of the research was to identify the factors that are related to the learning of innovation competences within two groups of students. According to Chi square tests, gender, study year, work experience, or course is not statistically associated with the learning of innovation competences, as shown in Table 3. The two groups of students based on their assessed learning of innovation competences did not differ in these variables.

Table 3. Chi-square tests and descriptive statistics for two groups of students learnt innovation competences by background variables

		Learning of innovation competences	
		Learnt less (*n*=32)	Learnt more (*n*=45)
Gender	Male	27 (43 %)	36 (57 %)
	Female	5 (36 %)	9 (64 %)
	$\chi^2 = .24, df = 1, p = .624$		
Study year	1st or 2nd year	17 (41 %)	25 (59 %)
	3rd or 4th year	15 (43 %)	20 (57 %)
	$\chi^2 = .05, df = 1, p = .833$		
Work experience	≤ 3 years	18 (45 %)	22 (55 %)
	> 3 years	14 (38 %)	23 (62 %)
	$\chi^2 = .41, df = 1, p = .524$		
Course	1	22 (47 %)	25 (53 %)
	2	8 (38 %)	13 (62 %)
	3	2 (22 %)	7 (78 %)
	$\chi^2 = 2.02, df = 2, p = .364$		

In contrast, conducted t-tests in Table 4 show that students' motivation for the course, considered importance of learning during the course, atmosphere of the course, learning of field-specific contents, and project-based learning preference are related to learning of innovation competences. The group that reported having learnt more innovation competences, score higher in motivation and consider the learning more important during the course than those who reported having learnt less. Similarly, those who assessed they learnt more innovation competences, described the atmosphere in the course as more supportive and safer, and that it encouraged discussions. These students were also more likely to report having learnt field-specific contents in the course. Furthermore, the group that reported having learnt more innovation competences, also preferred project-based courses to traditional lectures slightly more than the group that had learnt less. Instead, learning of innovation competences was not related to the support and guidance students reported having received during the course.

Table 4. Factors related to learning of innovation competences

Variable	Cluster 1 Learnt less (*n*=32)		Cluster 2 Learnt more (*n*=45)			
	M	*SD*	*M*	*SD*	*df*	*t*
Motivation for the course	3.00	.80	4.04	.82	75	-5.54***
The importance of learning	3.56	.72	4.33	.74	75	-4.57***
Atmosphere of the course	3.53	.80	4.24	.83	75	-3.77***
Learning of field-specific contents	2.97	1.12	3.76	.91	75	-3.40**
Project-based learning preference	3.00	1.11	3.49	1.01	75	-2.01*
Support and guidance	3.50	.72	3.80	.99	75	-1.54

Conclusion and discussion

This article has demonstrated an example of educational practice of activity-based learning in university-company cooperation and researched whether that kind of learning environment supports students' innovation competences. This study shows that university-company cooperation with activity-based learning methods seems to develop students' innovation competences. The students assessed that they have learnt innovation competences during the courses, especially creativity, critical thinking, and teamwork. The results are in line with previous studies on university-company cooperation (Quintana et al., 2016; Rossano et al., 2016) or activity-based learning (Henrico, 2012; Levine & Guy, 2007; Michael, 2006; Vila et al., 2012). In addition to the quantitative data of self-assessments and to cover some of its limitations, group interviews for students (*n*=30) were conducted on one of the courses. The aim was to gather qualitative information about students' learning of innovation competences. The results of the interviews (Keinänen & Butter, 2017) are also consistent with the result of this study. The interviews show that the learning environments of university-company cooperation contribute significantly to students' innovation competences development. According to the results, an authentic assignment and cooperation with company works as a natural platform for learning innovation competences.

This study suggests that all students are able to learn innovation competences. There were no differences in learning outcomes by gender, study year, work experience, or course. Instead, certain individual and environmental factors support the learning of innovation competences. The results of this study revealed two groups of learners: those who learnt less innovation competences and those who learnt more. Students' motivation, the importance of learning, and an encouraging atmosphere in the course distinguished these two groups from each other. Studies of students' approaches to learning have also found different groups of learners, and similar factors linked to

learning, including atmosphere and motivation. Although this study does not cover approaches to learning, the groups of students have similar characteristics to those in e.g. Hailikari and Parpala's (2014). The students who claimed to have learnt more innovation competences may be associated with a deep approach and the other group with a surface approach. Virtanen and Tynjälä (2016) have also shown that a positive learning atmosphere during the course is one of the key factors in learning of generic skills. Also, earlier innovation studies concerning innovation performance at the organization level have shown that from the individual factors, the employee's motivation is one of the key elements for promoting innovation (Quintana et al., 2016, 13). Therefore, designers of learning environments and courses, such as lecturers, should be more mindful of creating a safe and supportive atmosphere that motivates students. It is also important that a lecturer has needed skills to this (Konst & Scheinin, in press).

Another important finding of this study is that the students who assessed they learnt more innovation competences also claimed to have learnt more field-specific contents. This study showed that with the activity-based learning methods students are able to learn both innovation competences and programme-specific contents. These outcomes are not mutually exclusive. Henrico (2012) has also shown that activity-based teaching will not only enrich contacts sessions, but also improve the skills needed in business today: problem-solving, responsibility, communication, and critical thinking. Rossano et al. (2016) found similar results researching students learning in university-business cooperation based on problem-based learning. Heinis, Goller and Meboldt (2016) highlight that future of professional education needs broader and more competency-based schooling. The purpose of engineering education is to train students to become successful engineers who possess technical expertise, social awareness, and bias toward innovation. Higher education has therefore two challenges: to teach technical knowledge that students are able to apply in their future work, and to teach the social and individual competencies needed to use the acquired technical knowledge and expertise. The courses in this article do both. The study shows that students do not always have to be in workplace to learn needed competences. University-company cooperation as part of the course could be a good starting point for universities and regions with a less developed structure for university-business cooperation. Nielsen and Cappelen (2014) show that there is a need for incentive structures that encourage interaction and collaboration with companies and that bring students into ongoing research projects.

Project-based learning preference seems to be linked to the learning of innovation competences. One explanation for this could be that some prefer active learning methods more than others. Students who assessed that they learnt less could be described more like passive players in the classroom according to their behaviour or action related to innovation competences. Therefore, these students might prefer more traditional teacher-centred methods where students' role is more passive. On the other hand, it is important to note that the group label 'learnt less' does not imply that the level of their learning was remarkably low. However, it is one of the lecturer's responsibilities to make students understand what will be needed and nec-

For higher education to be effective, more effort should be put into recognizing and supporting different learners.

essary in their professional lives (Henrico, 2012). Therefore, discussion of individual learning preferences, how to develop them, and explain why specific learning methods are used in the courses, and what is expected from students, is important to maximize powerful learning. At the same time, in this study the relation to the two different learning preferences is quite weak, so further investigation is needed. Surprisingly, students' experience of received support and guidance during the course was not related to the learning of innovation competences, as previous studies of different learning contexts have suggested (Hailikari & Parpala, 2014; Virtanen et al., 2014). However, creating supportive, encouraging, and motivating learning environments requires a lot of guidance and guidance skills from a lecturer (Konst & Scheinin, in press), which is not necessarily always explicit to students. Nonetheless, due to the limitations of this case study, general conclusions may not be drawn.

In further investigations, a larger number of respondents and students from different study fields are needed. Because of the case study setting and a small sample, there are limitations to the generalizability of findings, and there is a possible bias with self-assessment. Despite the validity of self-assessment is contested, numerous advantages support the use of self-report, e.g. people possess better quality of information about themselves (e.g. Paulhus & Vazire, 2007, 226–229). Furthermore, the validation study (Butter & van Beest, 2017) shows there are reasonable correlations between the self-assessment scores and external indicators of innovation capacity. Motivation, atmosphere, support and guidance are complex phenomena, and hence require more extensive research. The focus of this study was on the learning of innovation competences by applying a novel tool, whereupon other variables were covered more narrowly, only with single variables. Future research should focus on examining the factors that support an encouraging and safe atmosphere, and students' motivational factors. This study focused only on the students' perception of learning. Therefore, in the future research perceptions of lecturers or representatives of companies could also be taken into account. Moreover, passive learners should be observed more. For higher education to be effective, more effort should be put into recognizing and supporting different learners with a variety of activity-based learning methods. Although there are some limitations to this study, the results are encouraging and give important information to understand how to develop more effective pedagogical practices. To respond to the changing needs of working life, the elements that support the learning of innovation competences should be recognised.

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