Hero, L.-M. (2017). Innovation tournament as a multidisciplinary activity system to promote the development of innovation competence. *Ammattikasvatuksen aikakauskirja*, *19*(4), 8–31.

Innovation tournament as a multidisciplinary activity system to promote the development of innovation competence

Laura-Maija Hero
MSc, PhD Candidate
Craft, Design and Technology Education,
University of Turku
Senior lecturer
Cultural management,
Metropolia University of applied sciences
laura-maija.hero@metropolia.fi

VERTAISARVIOITU
KOLLEGIALT GRANSKAD
PEER-REVIEWED
www.tsv.fi/tunnus

Abstract

Strengthening the contribution of education to innovation requires action across all higher education institutions. This article reports the findings of a study that examined innovation tournament as a multidisciplinary pedagogical activity system for the development of innovation competence in an institutional context that combined vocational secondary (vocational college) and tertiary (university of applied sciences) students. The focus was on the design of the activity system and the solutions found in the design phase concerning the following system components: subject, community, object, rules, tools and division of labour. The research question was: What kind of multidisciplinary pedagogical activity system facilitates the development of innova-

tion competence? The method used was a theory-based qualitative activity system analysis, and the research material consisted of annotated teacher–producer planning meeting videos. The study found tensions and solutions for the learning subject and community formation, as well as for the tournament object formation concerning tasks, ways of working, assessment methods and the challenges from companies. The study also found solutions for tournament rules, division of labour and tools, such as processes, methods of choosing the winners, prizes, assessment criteria and the technical tools. To support the development of innovation competence, the activity system was organised in seven weeks rounds with weekly tasks: the orientation (future orientation, innovation theory), idea, concept, prototype and testing, implementation, entrepreneurship and assessment rounds. The study concludes with a model of a pedagogical innovation tournament activity system for teachers' pedagogical use in higher and vocational education contexts. Future research in this area should focus on assessment methods for innovation competence.

Keywords: *Innovation tournament, activity theory, innovation competence, activity system analysis ASA, multi-grade learning, multidisciplinary team, vocational education, university of applied sciences*

Innovaatiokompetenssin kehittymistä fasilitoiva monialainen innovaatioturnaus pedagogisena toimintajärjestelmänä

Tiivistelmä

Verkostomainen innovaatiotoiminta yritysten, eri asteisten korkea-asteen- ja ammatillisten oppilaitosten opiskelijoiden ja opettajien yhteistoimintana on tarpeellista uusien innovaatioiden mahdollistamiseksi ja innovaatiokyvykkyyden lisäämiseksi. Tutkimuksessa selvitetään, minkälainen innovaatioturnaustoiminta parhaiten tukee innovaatiokompetenssien kehittymistä yritysten ja oppilaitosyhteistyön kontekstissa. Tutkimusaineisto koostuu opettajien yhteistoiminnallisten suunnittelukokousten videoinneista kahden monialaisen ja moniasteisen innovaatioturnauspilotin yhteydessä. Toimintajärjestelmän osatekijöitä tarkastellaan keskusteluissa esiintyvien jännitteiden ja niihin löydettyjen ratkaisujen avulla. Tutkimusaineistot analysoitiin teorialähtöisellä toimintajärjestelmän analyysin menetelmällä. Tulosten perusteella turnauksen tavoitteeksi mallintui uudenlainen, markkinoille saakka suunniteltu tuote tai palvelu yritykselle, innovaatioprosessin ja uusien teknologioiden ymmärtäminen sekä tiimissä toimivien yksilöiden innovaatiokompetenssien todennettu kehittyminen prosessin aikana. Turnauksen oppiva subjekti määräytyi opiskelijoista ja heidän verkostostaan muodostuvaksi kokonaisuudeksi. Turnauksen säännöt ja arviointi koostuivat ratkaisun, innovaatiokompetenssien sekä eri alojen opiskelijoiden opetussuunnitelman mukaisista arviointikriteereistä. Työnjakoa määrää turnauksen tuotannon ja pedagogisen työn vaatimukset ja resurssit. Tarpeelliset työkalut ovat turnauskierrokset tehtävineen, esittely- ja valmennustilaisuudet, teoriaopinnot, pisteytysjärjestelmät sekä tekniset välineet. Tuloksista ilmenee, että kompetenssien kehittymistä tukeva pedagoginen innovaatioprosessi sisältää innovaatioteoriaa ja tulevaisuusorientaation harjoittamista, idea-, konseptointi-, prototypointi ja testaus sekä tuotteen implementointi- ja yrityksen koeponnistus- sekä arviointivaiheita. Vaikka sovellettua innovaatiokompetenssien kriteeristöä pidettiin soveltuvana ja kattavana, itsearviointia ei koet-

tu soveltuvaksi arvioinnin välineeksi, koska kyseessä on kilpailu. Valittujen innovaatiokompetenssikriteerien mukainen opettajien viikoittainen havaintopäiväkirja, opiskelijan vahvuuksien ja heikkouksien kehittymistä todentava työpaja 2-3 kertaa turnauksen aikana ja tiimin portfolio osaamisen näkyväksi tekemiseksi koettiin soveltuviksi menetelmiksi. Johtopäätöksenä luotiin pedagogisen innovaatioturnauksen toimintajärjestelmän malli, jota opettajat voivat käyttää ammatillisen ja korkeakoulutuksen konteksteissa.

Avainsanat: *Innovaatioturnaus, toiminnan teoria, innovaatiokyvykkyys, innovaatiokompetenssi, toimintasysteemin analyysi, moniasteinen oppiminen, monialainen tiimi, ammatillinen koulutus, ammattikorkeakoulu*

Introduction

To ensure higher education institutions contribute to innovation, the European Commission (2017) emphasises the development of innovation skills. Educational institutions need to build an outward-looking culture of innovation and entrepreneurship with activities based around real-world problems. The European Commission (2012) has also called for new partnerships to improve open innovation and multi-disciplinary knowledge sharing for the rapid prototyping of new products, services, processes, structures and systems. In the context of higher vocational education, this calls for novel types of activity systems for multi-grade and multi-disciplinary learning. As a part of the curricula, innovation tournament activities are seldom used for project-based learning to facilitate pre-defined competence development. They are potentially a way to organise networked cooperation between different grades of vocational institutions, society and local companies.

Historically innovation tournaments are a specialised goal-oriented form of idea competition outside formal education and its permanent institutions. Innovation tournaments have captured global attention in recent years. Through a series of carefully designed stages, innovation tournaments aim at generating and collecting valuable ideas, as well identifying potentially commercialisable innovation opportunities (Terwiesch & Ulrich, 2010). Some studies have examined competition as a model for the innovation process (Kay, 2011; Duverger & Hassan, 2007) and its governance (Morgan & Wang, 2010; Pedersen et al., 2013). Existing research has also explored the management models of innovation tournaments (Adamczyk et al., 2012; Boudreau et al., 2011; Malhotra & Majchrzak, 2014) and social processes among participants (e.g. Füller et al., 2006). Konst & Jagiello-Rusilowski (2017) explored innovation competence, namely resilience and self-efficacy, development during an "innovation camp", a pedagogical innovation process similar to short tournament models. Passaro, Quinto & Thomas (2017) analysed the potential of start-up competitions as a learning environment for entrepreneurial processes. They noted a difference between start-up competitions and innovation tournaments. Such competitions generally involve small companies in search for funding. In innovation tournaments, individual participants form teams, and the ideas and solutions of the individual people in the team can lead to valuable innovation opportunities for the involved or-

ganisations recruited by the tournament organiser. A systematic and comprehensive analysis of innovation tournament as a pedagogical activity system for the development of innovation competence as a part of the vocational education curriculum is still missing. In this study, we focus on the collaborative planning and piloting phase of an innovation tournament from teachers' perspective. The aim is to understand what kind of multidisciplinary tournament activity system facilitates the development of innovation competence.

Tournament as a pedagogical activity system for competence development

Tournament as a pedagogical environment

Socio-cultural interpretations regard the spaces of dialogue as central in the analysis of collaborative creativity. These spaces can lead to the emergence of collaborative agency and to a joint project that is oriented to create a new object or artefact that is able to solve e.g. a social or technological problem (Miettinen & Lehenkari, 2016, p. 238). Taatila, Suomala, Siltala and Keskinen (2006) proposed that an innovation project is a social phenomenon that brings the competence of several individuals together through social processes supported by shared resources. An innovation project is a social process through which a novel idea is turned into a practical reality. Innovation project activities are designed by teachers, firms and other working life organisations as problem- or project-based development activities that can be called pedagogical innovation processes (Lepistö & Lindfors, 2015; Rautkorpi & Hero, 2017). A pedagogical innovation process is understood as an authentic learning activity in which collaboratively created ideas are transformed into a concrete end result, prototyped and tested, and implemented to convey value in the surrounding world through interactions with several stakeholders (see Sawyer, 2006). At the centre of the activity is a problem or challenge from working life and an object-oriented goal to produce a novel solution for such a problem.

The possibility of a new object – a product or service, for example – is based on the complementarity of the knowledge and resources of the participants involved (Miettinen & Lehenkari, 2016; O'Reilly et al., 1998; Hakkarainen et al., 2004). Therefore, multi-disciplinary teams are used as an approach to organise higher education learning projects for simulating working life conditions (e.g. Sloep, Berlanga & Retalis, 2014; Van Der Vegt & Buderson, 2005). This transformation from an individual-centred to a systemic and socio-cultural approach in organising learning sets the starting point for innovation tournament as an activity system. Understanding the system as a whole is important. From a socio-cultural perspective, the focus is on collaborative knowledge creation (e.g. Hakkarainen et al., 2004), as well as the social processes taking place in the course of creating and implementing something new. The aim and objective of the activity can be set to develop the pre-defined competencies.

Learning design as an activity system

According to Scott et al. (2010), learning designs aimed at supporting transformational change could significantly benefit from the adoption of socio-historical and socio-cultural analysis approaches. Such systemic perspectives are gaining greater importance in education, as they facilitate

the understanding of complex interactions between learning environments and human activity. Jonassen & Rohrer-Murphy (1999) argued that activity theory (AT) provides an appropriate framework for designing learning environments. Activity systems (Engeström, 1987, 2014) involve a subject, a community, an object, tools, rules and division of labour used in the activity, and the actions and operations that affect the outcome (Nardi, 1996).

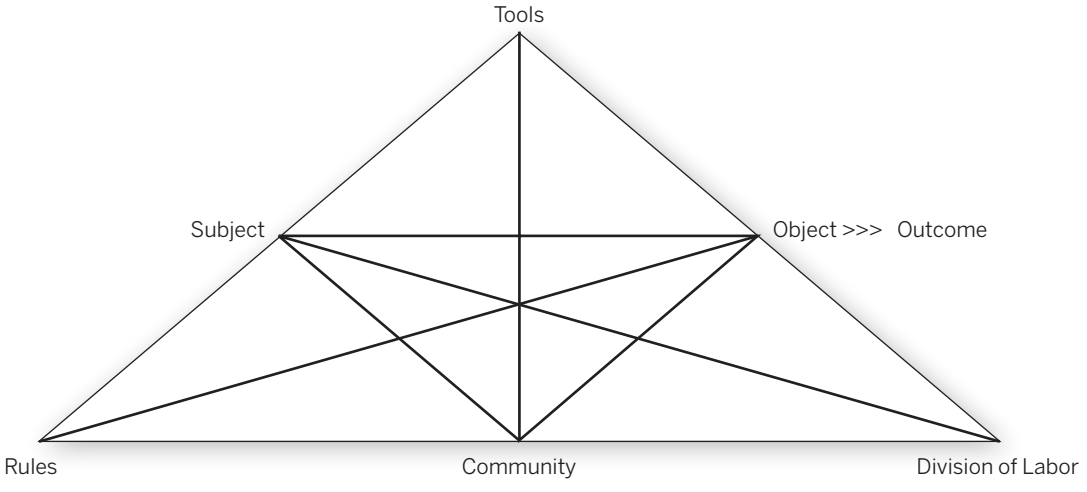

Figure 1. Activity system framework (adapted from Engeström, 1987; see also Engeström, 2014)

In this framework (Figure 1), the subject of the pedagogical activity system is the individual or groups of individuals involved in the activity. The community is the social group that the subject belongs to whilst engaged in the activity. The object of the activity is the physical or mental product that is sought. It represents the intention that motivates the activity. The tools include social others and the artefacts that can act as resources for the subject in the activity. The rules are any formal or informal regulations that can, in varying degrees, affect how the activity takes place. The division of labour refers to how the tasks are shared among the community. The outcome of the activity system is the end-result of the activity (Engeström, 1987; see also Jonassen & Rohrer-Murphy, 1999). Designing the right types of activity systems to facilitate innovation learning (Bruton, 2011; Lindfors & Hilmola, 2016; Sawyer, 2014) can have immediate, observable effects on competence development (Pant, 2012; Amabile, 1996).

Individual innovation competence as a targeted outcome

By understanding competency outcomes, innovation processes, such as tournament systems, can be applied for educational purposes to foster learning. The learning process can be organised to address competency gaps in relation to the desired problem solving and the future-oriented, innovative solution. To ensure that higher education institutions contribute to innovation, the European Commission (2017)

emphasises the development of skills for innovation. There are several innovation competence models with different innovation definitions that are created based on literature reviews. E.g. Marin-Garcia et al. 2016 demonstrated the differences and similarities of several models and based on this research, discovered a "Fincoda" self-assessment survey method usable in educational and organizational contexts. According to a recent systematic review (Hero et al. 2017), individual innovation competence relates to the personal characteristics, attitudes, skills and knowledge needed in intentional collaborative novel solution creation processes whose outcome is aimed to be an innovation. According to the studied empirical material, these personal characteristics are *flexibility* (e.g. Nielsen, 2015), *motivation* (Edwards-Sachter et. al., 2015; Montani et al., 2014; Waychal et al., 2011), *engagement* (Chatenier et al., 2010; Chell & Althayde, 2011), *self-esteem* (Avvisati et al., 2013; Santandreu-Mascarell et al., 2013) and *self-management* (Bjornali & Støren, 2012; Chatenier et al., 2010). The skills and abilities are *future thinking skills* (Montani et al., 2014; Vila et al., 2014; Waychal et al., 2011), *risk-taking abilities* (e.g. Nielsen, 2015; Santandreu-Mascarell et al., 2013), *creativity and learning skills* (e.g. Chatenier et al., 2010; Edwards-Schachter et. al., 2015), *social skills*, such as cooperation, networking and communication skills (e.g. Avvisati et al., 2013; Bjornali & Støren, 2012; Santandreu-Mascarell et al., 2013), *project management skills* (e.g. Chatenier et al., 2010; Nielsen, 2015), *decision-making skills* (Wang & Shuai, 2013; Waychal et al., 2011), *making skills*, such as designing and prototyping skills (Bruton, 2011) and technical skills (Arvanitis & Stucki, 2012). Knowledge is related to the mastery of one's own field or discipline and knowledge of other fields or disciplines (e.g. Avvisati et al., 2013; Bjornali & Støren, 2012). As a goal-directed activity system for learning, the pedagogical innovation process should enable the development of these competencies.

Context: The collaborative tournament design process

The context of this study is a joint planning activity of secondary and tertiary vocational teachers and producers of two Finnish vocational education institutions, Omnia Vocational College (secondary-level vocational education) and Metropolia University of Applied Sciences (tertiary level, i.e. higher vocational education).[1] The tournament planning forum consisted of 17 experts from different fields, 13 of whom were vocational teachers acting as tutors of the project work (5 from Omnia and 5 from Metropolia, 3 teacher trainees), 3 were production staff and 1 external consultant specialised in innovation tournament production. Teachers represented the cultural management, business, entrepreneurship, digital communications, textile design, social and service design study fields. A teacher forum developed and piloted a pedagogical tournament model based on AT, innovation process theories (see Baregheh et al., 2009; Eveleens, 2010), innovation competence research (see definition in Chapter 2.3) and a multi-disciplinary teacher–producer team workshop activity.

[1]Omnia Vocational College, Finland is a multi-sector vocational education institution with over 8,000 students studying for a vocational qualification. Metropolia University of Applied Sciences is Finland's largest university of applied sciences that educates in the fields of culture, business, health care and social services and technology, with over 16,000 students and 67 degree programs.

The targeted outcome of the activity system (see Figure 1) was set in advance. The activity system should target the development of innovation competence and produce a novel solution (i.e. a product, service) for a company or other working life organisation. Based on this target, the pre-conditions for the design of the activity system in the teacher forum were as follows: 1. Innovation was understood as a concept emphasising not only the process of creation but also of concretising, applying and implementing in the market or the environment. Traditionally, it not only refers to novel products but also new services, processes, business models and new production methods, to name a few (Schumpeter, 1942). More recently, whilst the definition has focused on the outcome, it is defined as a product, service or process that is considered new in the environment into which it is introduced (e.g. Damanpour, 1991; Dougherty, 1992; Marcus, 1988). 2. For the purposes of designing the activity, innovation was not defined primarily as a static concept about the result; rather, what was of interest was the processes leading to the innovative outcome (following e.g. Baregheh, Rowley, & Sambrook, 2009). The overall task of the student teams was to create a novel and unique solution for the given working life challenge. This product was openly called 'an innovation', as the students were set to reach for such a solution (product, service, process, etc.) following the given definition. 3. Innovation competence was defined as flexibility, achievement orientation, motivation and engagement, self-esteem and self-management, future orientation, creative thinking skills, social skills, project management skills, and content knowledge and making skills that can be needed in the collaborative innovation process (Hero et al. 2017, see Chapter 2.3). 4. The learning activity system should facilitate multi-grade teaching, grouping and multi-disciplinary project work. Multi-grade teaching refers to the teaching of students of different ages, grades and abilities in the same group (e.g. Miller, 1991), and multi-grade grouping to involving different grades of students in a team (e.g. Leton & Anderson, 1964). These pre-conditions would also be communicated to the students openly.

Research design

Research question

The focus of this study is in the design of the innovation tournament activity system. The aim is to understand the macro-level activity system by studying the solutions that teachers found for the activity system components. The design phase was unfolded to be able to formulate such a systemic model. The co-design of the teachers reveals the tensions and solutions in planning the structural and procedural characteristics of the goal-oriented activity system. The goal is to model the activity system based on the solutions found by the teachers in the planning, piloting, execution and evaluation phases of the development process. We delimit the focus to the talk about the activity system components—the subject, the community, the object, rules, tools and division of labour (adapted from the activity system model by Engeström, 1987, 2014). The research question was formulated accordingly: What kind of multidisciplinary pedagogical activity system facilitates the development of innovation competence? This question is important for the teachers and administrators planning innovation tournaments or similar learning systems or environments in vocational and higher education contexts.

Table 1. Teacher forum meetings video material

Session	Date	Video lenght	Topics	Participants N=
Workshop I	26.9.2016	43'44	Theoretical assumptions and philosophical background. Previous experiences.	8
Workshop II	17.11.2016	52'37	Tournament structure planning.	9
Workshop III	8.12.2016	34'09	Pedagogical action planning.	10
Workshop IV	12.1.2017	1 h 54´15	Getting ready for the pilot: pedagogical action planning.	12
Workshop V	27.3.2017	1 h 19'18	Assessment of the pilot 1.	9
Workshop VI	15.5.2017	3 h 47'3	Planning pilot 2 (learning from the 1. pilot).	9
Workshop VII	30.5.2017	2 h 52'48	Planning pilot 2 continues.	10

Total duration: 12 h 4'21". Unique participants: N=17 of which N=13 teachers (N=5 from vocational college Omnia and N=8 from university of applied sciences Metropolia UAS) and N=4 production staff members.

Materials and method

The material consisted of multi-disciplinary and multi-grade teacher–producer workshop observations (Table 1). The material was collected during autumn 2016 and spring 2017 in workshop meetings. It was videotaped in the workshop meetings of the teachers and producers (later teacher forum) before the first innovation tournament pilot, after it and whilst planning the second pilot.

Activity system analysis (ASA), an AT-based method for developing constructivist learning environments proposed by Jonassen and Rohrer-Murphy (1999), shaped the study design. This approach is intended to match activity system components (Engeström, 1987) for providing the foundation for the design of such environments. Moreover, the analysis utilises a framework based on AT to examine the system elements underlying innovation tournament practices. The advantage of using ASA in this study is that it provides a method to extract the essence of complex data sets in a graphic model, and these data sets can then be compared with those of other similar system studies (Yamagata-Lynch, 2010).

In the first phase, the videotapes were annotated (see e.g. Sloetjes & Wittenburg, 2008; Derry et al., 2010) with Elan video annotation software (Elan, 2017). The part-to-whole deductive approach introduced by Erickson (2006) was applied in annotating the material. The annotated events in this case were defined to be those presenting a tension–solution trajectory (part) related to the AT model determinant subject, the community, the object, tools, rules and division of labour (whole) (Engeström, 1987). These determinants were defined as the 'tiers' (Elan, 2017) or the themes of the annotation procedure.

To determine the possible tensions in the teachers' developmental interactions

towards discovering the solutions to activity system components, the analysis focused on the discussion passages that constructed the content of collaborative development. The data consist of tension–solution trajectories that reveal the solutions to activity system components. First, each annotation document (n=33 Word documents containing annotations of the video material with a length of 12 h 4'21") was reorganised with the procedural dialogue into trajectories of tension–solution talk. Tension talk was defined as discussion that results in either a positive or a negative critique or debate. Solution talk was defined as the resolution of the tension or as an agreement or decision made. These were identified by the criteria 'catalyses discussion among participants and needs a solution to allow to proceed further in the development of the activity system, ie. the tournament model'. Second, the tension talk and the solution talk were coded (Chi 1997) in episodes by conducting a data-driven, systematic qualitative content analysis (Krippendorff, 2013) through a careful re-reading and thematising of the data. The coded trajectories of the analysis were again organised according to the six components of the activity system framework (Jonassen & Rohrer-Murphy, 1999; Engeström, 1987, 2014) to unveil the entire activity system. In conclusion, the analysis frame used the components subject, community, object, rules, tools and division of labour.

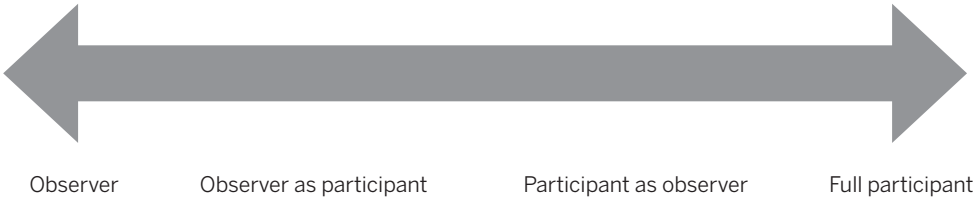

Figure 2. Participant–observer continuum (Glesne, 2005)

An AT investigator needs to consider his/her role in the study. According to Glesne (2005), investigators can take on many roles in the participant–observer continuum; they can be an 'observer' on one end or a 'full participant' on the other end (Figure 2). The best method, according to Glesne (2005), in gaining first-hand knowledge of participant experiences is to become a full participant in the community. This role may provide investigators with access to information that the participants feel comfortable sharing with their peers only. I facilitated the meetings and participated in the discussions, so I needed to regard myself as a full participant. The benefit of participating was that the participants openly shared their thoughts, and they trusted that their opinions were heard. Later, I still assumed the role of an observer whilst analysing the material. The findings are reported in the next chapter.

Findings: Teachers' solutions to activity system components

The solutions for designing the activity system components subject, community, object, rules, tools and division of labour are reported in the next chapters.

Solutions: Subject

According to the teachers, the mediating subject of the tournament is a single student and a multi-disciplinary and multi-grade team (Table 2).

Table 2. Solutions found in the teacher forum for the tensions concerning the activity system subject (Teacher Forums I–VII)

	Class	Factor	Tension	Solution
Subject	Students	Prior competence	Zone of proximal development diversity	Assessing the development of competence during tournament, not pre-defined competence level.
			Some students come from more innovation related disciplines than others.	Co-tutoring to understand learning needs.
	Multigrade and multidisciplinary teams	Motivation	Different types of interests and aims and previous experience.	Mandatory vs. obligatory course.
			Variations in motivation, self-esteem, social skills, attitudes.	Motivating factors: Applying for higher vocational education.
			Different types of interests, aims, motivation, previous experience, learning needs.	Complementarity of competences recognized. Strengths of all team members are found and communicated.

The 13 teams consisted of 2–3 VET students and 2–3 UAS students. The objective of the teams was to find a novel solution and develop team competence. Still, individual students are assessed according to the curricula. This created tension only in the design of the final tournament round when the credits were supposed to be registered. The entire system was a learning community.

Tension was involved in relation to the students' different zones of proximal development (concept used by teachers, e.g. Wass & Golding 2014). The learning needs and starting levels between VET and UAS students were very different. The solution to this was the agreement to assess the development of competence in the tournament and not the pre-defined competence level in the curriculum of one of the schools (Teacher Forum III). Some teachers also felt pressured about tutoring teams outside their comfort zone. Co-teaching was found to ease this pressure. Company representatives and judges found the schedules too tight, and this issue needed to be resolved next time by

providing the student team the created materials earlier.

The strength of the multi-disciplinary team formation seems to be the opportunity for the students and teachers to form new networks and gain peers, which is found to be professionally crucial for them.

Teacher A: This multi-disciplinary and multi-grade way of working is absolutely a must and should be kept in the next pilot, as well. It is important politically, ethically and socially.
Teacher B: …and it creates a difficult learning environment that resembles future working life, and offers an authentic learning experience. (Teacher Forum V)

Some tensions emerged in the discussions related to multi-grade team composition and the different learning needs. The zone of proximal development of the students varied significantly. This situation caused tensions, as the more competent students in teams must support the weaker students considerably. The students' self-guidance and proactiveness are on different levels. The pedagogical model required much independent work in teams. This issue was addressed by passing the responsibility of supporting the weaker and less proactive students to peers, ie. other team members. The best-functioning teams seemed to find a way to support the weaker students by assigning the roles in teams to those who manage work and to those who perform the given tasks.

The motivation to mix secondary and tertiary vocational students emerged from the idea that different competencies complement one another in a diverse team. If some team members can write perfect documents, some can make a prototype and some can present well; the team therefore becomes stronger than one individual or a pair. Some students planned to apply for UAS this year or in the near future; they were really excited and motivated. There were also students who realised their potential and started planning to apply in UAS. Then, there were a couple of students who were forced to come to this innovation tournament course; they could not find motivation or engagement. Some students came from disciplines that educated more innovation-related skills than others did. For example, project management skills are a part of many curricula, whereas any types of making skills to develop a prototype are a part of only a few disciplines.

Solutions: Community

The tournament community was planned to consist of several stakeholders (Table 3). At the core of the community was the VET and UAS students who were divided into multi-grade and multi-disciplinary teams based on their own project interests. Individual students chose two company challenges, and they were all nominated in the project challenges they wanted. The orientation round involved external speakers, such as futurists, innovators from companies and students who already passed the innovation project. A teacher pair tutored three to four teams of four to five students. A team had approximately half secondary (VET) and half higher vocational education students in the university of applied sciences (UAS). Some teams even used the opportunity to find new team members and grow their teams. (Teacher Forums I–II and VI).

The perfect companies to partner with were found to be those that are not expecting a pre-determined solution, but

Table 3. Solutions: Community (Teacher Forums I–VII)

	Class	Factor	Tension	Solution
Community	Students	VET and UAS students	Different types of interests and aims, motivation and previous experience.	Co-tutoring to understand learning needs. Complementarity of competences recognized.
		Multigrade and multidisciplinary teams	Team formation	Randomized team formation to quarantee equal opportunities in tournament.
	Coaches	Companies	Choosing the partnering firms and their challenge formation.	Teachers coach the companies and their challenge formation.
		Teachers	Different background and competences	Co-tutoring of VET/ UAS techers
		Judges	Assessment and scoring. Choosing and educating the judges. Whos responsibility?	Project manager
	Production staff	Project manager	Managers role	Manages tournament process, events, teacher training, R&D process, theory lectures
		Event producer	Responsibilities?	Pitching events, final event, organizing rooms, tools etc.
	Audience	Audience	Attendance and interest	Teachers invite school classes and company invites their networks.

are willing to take the risk and give an open and authentic problem to be solved through the development of a novel service, product or other end result (Teacher Forum IV). For the 13 teams, choosing four partner firms or firm pairs was considered optimal. Novel technologies were mixed with the companies' challenge to ensure that the challenges given were difficult enough and outside the participating students' own discipline or vocational field of study.

Teachers found it important to discuss and familiarise themselves with different vocations so that they could understand individual students' orientations in the project. Co-tutoring was found to be key in multi-grade and multi-disciplinary tutoring, as the teachers received support from one another in complex situations.

Solutions: Object

The object of the activity is the physical or mental product sought. It represents the intention that motivates the activity (Jonassen & Rohrer-Murphy, 1999). Tensions were found in the student, teacher and company objectives (Table 4).

Table 4. Solutions: Object (Teacher Forums I–VII)

	Class	Factor	Tension	Solution
Object	Student	To solve an authentic problem from work life	How to define the perfect challenge with the company to interest teams?	Challenges should be practical, outside every students discipline, enable a new product or service.
		Develop a novel solution and plan the implementation	Way of working	Multidisciplinary and multi-grade teams.
		Innovation competence	Is the used framework suitable?	Yes, but methods how to use the framework should be developed further.
		Understand innovation processes	How should the tournament tasks be organized?	Rounds: Orientation, idea, concept, prototype and testing, implementation, entrepreneurship and assessment. 1 round = 1 week = week tasks.
		Learn multigrade and multidisciplinary team work	Different types of competence development needs, interests and aims, motivation and previous experience.	Different competencies complement each other in a diverse team, and students get to experience authentic work life type team work.
			Ready-made teams vs. competence based self-organized teams?	Randomized team formation to quarantee equal opportunities in tournament and new networks.
		Entrepreneurship - start-up work	Way of working: As a project team or as a start-up company?	"Working as a start-up company" -thinking, as this is authentic work for students.
	Teacher	To assess innovation competence development	Assessment methods suitable for tournament? Self- and team peer-assessment methods can create unfair results.	Teacher observation with weekly diary, InnoCard workshops based on agreed competence framework.
		Create innovation climate	Should the teacher be a part of a team or distract and be objective?	What comes naturally from the teacher.

	Class	Factor	Tension	Solution
Object	Teacher	Training to become innovation tutor	Can training of a tutor be integrated to tournament planning and tutoring of the teams?	Teacher planning forum before, during and after the tournament
	Company	Get new ideas and concepts, even products and sevices	Producer - teacher - company relationship	Teacher in direct contact with the company
		Give suitable company challenge for students	How to formulate an open and inspirational challenge?	Techers should be negotiating, they know the students in their institutions.
		Get networked with young people	How to facilitate student - company work?	Teacher organises pitching and coaching sessions, students also in direct contact.

The tournament macro-level objectives for the students were to gain team innovation competence and innovation process understanding and to develop the best solution for the partner company or organisation, learn how to work in a diverse team and gain an understanding of modern technologies in disciplines other than engineering. The tournament objectives were found to be interesting and challenging enough for the students, and the outcomes created went beyond the idea level (Teacher Forums VI, VII). *The objective to work like a small start-up company was considered to increase engagement (Teacher Forum VII).*

The objective of the teachers' planning phase was to find a challenge or an open problem from a company or external organisation. This task is often difficult even for a management consultant, and more so for a teacher. Authentic cooperation with companies created tension because the production staff was responsible for negotiating and making an agreement with the companies. In the next tournament, however, no such resource will be available, and the work will be done by teachers. Teachers needed the forum to discuss and learn from one another so that they can package the challenge in an interesting form for all students. The challenge as an objective for solution development needed to incite the interest of and motivate all students, not just those from one discipline.

Solutions: Rules

The teacher forum found three kinds of assessment criteria as rules for the tournament course (Table 5).

Table 5. Solutions: Rules (Teacher Forums I–VII)

	Class	Factor	Tension	Solution
Rules	Tournament	Solution assessment	Rules unclear for teachers	Clarified scoring system (Market need, implementability, presentation, challenge compatibility)
			Some students felt scoring unequal	More transparent score system
		Innovation competence assessment	What criteria to use, curriculum or research based?	Assessment criteria based on recent research.
			What methods are reliable in a tournament?	Teachers assess competence development based on student demonstrations.
	Pedagogical	Course assessesment	Curriculum vs. tournament	A tournament as institutional education should also be understood according to curriculum.
			Classroom rules, who defines?	Teacher
			Distant work rules: Who defines?	Teams and teachers together

The tournament rules for solution (i.e. novel product or service to benefit working life) development were benchmarked from previous hackathons organised in the area. The solution assessment criteria were novelty, market need, presentation, implementability and challenge compatibility. Flexibility, achievement orientation, motivation and engagement, self-esteem, self-management, future orientation, creative thinking skills, social skills, project management skills, content knowledge and making skills were accepted as usable and comprehensive innovation competence criteria (according to Hero et al. 2017). Project and network working skills, joint participation, group work, meeting and communication skills, professional knowledge, problem solving, innovation skills and capability to react to abrupt changes were set as the individual student course assessment criteria, according to UAS curriculum.

The rules were communicated in advance, but the criteria were not transparent enough. The competence development rules were communicated in the orientation seminar, but the scoring system was not developed adequately to be explained unequivocally. The objective to demonstrate the individual development

of innovation competence of the team members was set to be assessed also by the tutoring teachers. The scoring system of competencies remained abstract, as it did not have a similar visual representation nor a scorecard as the solution score system had. According to teacher forums III–VII, the competence scoring systems were impossible to communicate, as they needed learning and practical workshop work to be understood by the students. This problem was solved by separating the criteria that concerned the solution, the team member competence development and the individual student course assessment.

Solutions: Tools

The teachers found pedagogical and tournament competition-related solutions whilst designing the tools (Table 6).

Table 6. Solutions: Tools. (Teacher Forums I–VII)

	Class	Factor	Tension	Solution
Tools	Tournament	Tournament rounds	Should there be future and entrepreneurship rounds to facilitate these competencies?	Future orientation and entrepreneurship rounds added to next pilot.
		Pitching events	Big events of 120 persons. Who organizes?	Producer hired
		Solution assessment	Teachers and students did not properly undestand the solution assessment criteria	Clarified scoring system
		Tournament prizes	Prizes were not equally valuable	Same prizes from all challenge companies
		Competence assessment	What methods are reliable?	Peer-aseessment workshops like InnoCards and teacher observation diary. Develop further based on individual innovation competence framework.
		Authentic challenges from companies	Who should negotiate? Production staff or teachers?	Teachers
		Work certificates	Drafted by students on a template	Teacher should be respontible to write draft, company to sign.
		Own computers and mobile phones	Only few had, mostly higher education students	Needs to be emphazised in advance
	Pedagogical	Team portfolio	Communicates poorly the competence development of the teams and students	Teachers should emphasize and tutor the teams to reflect more on their learning
		Innovation tools -theory lectures	Too heavy for secondary students	Make them more interactive and shorter

	Class	Factor	Tension	Solution
Tools	Peda-gogical	Future orientation	Future orientation is missing from the weekly rounds	A pedagogical plan made to help all teachers to facilitate it.
		Weekly tutoring	The teams would have needed more tutoring to engage better.	To increase the resource.
		Individual student assessment	How to assess an individual student and define marks for the register?	Individual course assess-ment should still be made according to UAS curriculum

The innovation tournament as an authentic, multi-disciplinary and multi-grade gaming experience was considered challenging but inspirational tool for innovation learning. Forming randomly multi-disciplinary and multi-grade teams that are as equal as possible at the beginning of the tournament resulted in positive tensions in the discussions (Teacher Forums VI and VII). The tensions in planning the tournament concerned creating and piloting the tools for the tournament in terms of the tournament rounds and weekly tasks, pitching events, solution assessment, tournament prizes and competence assessment tools, and authentic challenges from companies. The solutions related to the pedagogical tools concerned the work certificates, own computers and mobile phones, team portfolio tasks, innovation tools, such as theory lectures, integrating future orientation methods, the weekly tutoring resource and the individual student assessment at the end of the course.

The scoring systems should have been more transparent. Two separate scoring systems were used: one for the judges to assess the created solution in the concept, proto and final pitch phases of the tournament and another for the teachers to assess team competence development. The scoring system for the evaluation of solution development created tension between the production staff and the teachers. The teachers did not understand the scoring system that the judges used; they were not briefed properly. The teachers found that some of the scores the judges gave were inconsistent. Some gave very high scores to each team, whereas some gave very low scores. This issue created tension between the teachers and the teams, as some of the students found the scores to be unfair (Teacher Forum VI).

Several competence development and measuring methods were co-developed based on the agreed criteria (Hero et al. 2017) to enable the sharing of personal strengths and weaknesses in the teams and to prove competence development from start to finish. The technical competence development scoring system as a shared Excel sheet was considered undeveloped and not transparent enough. How should the competence scoring system function? Who assesses it? Only teachers? What are the methods that teams could use to prove competence development? These questions needed answers, and finding them required negotiation. Self and peer assessment methods were tested, but as this was a competition, such approaches were not found to be fair and reliable (Teacher Forum V). The teachers considered the teacher observation diary and the "Inno-

Cards" gamified workshop method (based on the chosen innovation competence criteria) the most reliable methods. The diary allowed teacher observation on weekly basis. The gamified workshop allowed observation, discussion and documentation two to three times during the tournament. (Teacher Forum VI). The teachers found it important that the teams could prove and show their development. Assessment was considered a skill that should develop in this type of project learning. The team portfolio was set as the core of the documentation process (Teacher Forum VII).

Solutions: Division of labour

The main tensions were about the tutoring resources and the tournament production responsibilities (Table 7).

Table 7. Solution: Division of Labour (Teacher Forums I–VII)

	Class	Factor	Tension	Solution
Division of labour	Production work	Production	Room reservations, pitching events, marketing	Marketing is teachers work.
	Pedagogical work	Tutoring resources	Overlapping work (other courses at the same time)	Careful planning
		Teacher training	Teacher competence in innovation work	Integrated training
		Pairing teachers with challenge companies	Teacher competence and interests motivate work	Negotiations
		Assessment	Teachers or production staff work	Competence assessment is pedagogical work of teachers, solution assessment by external judges and companies.

As the tournament model was designed to be a seven-week full-day project course, both the teachers and the students encountered challenges in managing their time for it. Some teachers had other courses to teach, and some students had other mandatory courses to attend. This issue created a feeling of being always late in weekly tasks or stress in trying to cope with the pace of the tournament. A teacher had only one physical tutoring day, and this was considered too short to accomplish the set outcomes. The role of the teacher resembled that of a coach. Still, as each team had under-age students, some of the students needed more support. More time was needed, especially for the problematic teams who had issues in cooperation between team members, or for the problematic individuals who had issues in their personal lives and studies. As the teachers worked mostly in pairs, they felt that working with a teacher pair helped in organising the work, as they also had to tutor students from unfamiliar schools. (Teacher Forums IV–V.)

Tensions in the production of the tournament also occurred. Inviting judges is the job of the production staff. The pitching events are quite large productions, with over 100 persons attending and several screens needed, the students' presentations downloaded in advance, the judges invited and the space organised. Normally, the production resources available in schools are limited. Marketing was supposed to be the work of the production staff, but it clearly required the teachers' pedagogical skills. As the innovation project was clearly a part of the curriculum of UAS students, a negotiation or other types of tutoring sessions are needed when recruiting students. (Teacher Forum VII.)

Discussion and conclusion

The tournament activity system was designed as a teacher forum collaboration (teacher forums I–VII) to achieve innovation outcomes for participating companies and competence development for students. The findings of this study confirm the expected complexity of bringing innovation tournaments in multi-disciplinary and multi-grade institutional contexts. The tensions in the teacher design process to find solutions for the subject, community, object, rules, tools and division of labour were manifold and complex, but not severe or impossible to solve. The solutions found for these components enabled the formation of the activity system (Figure 3).

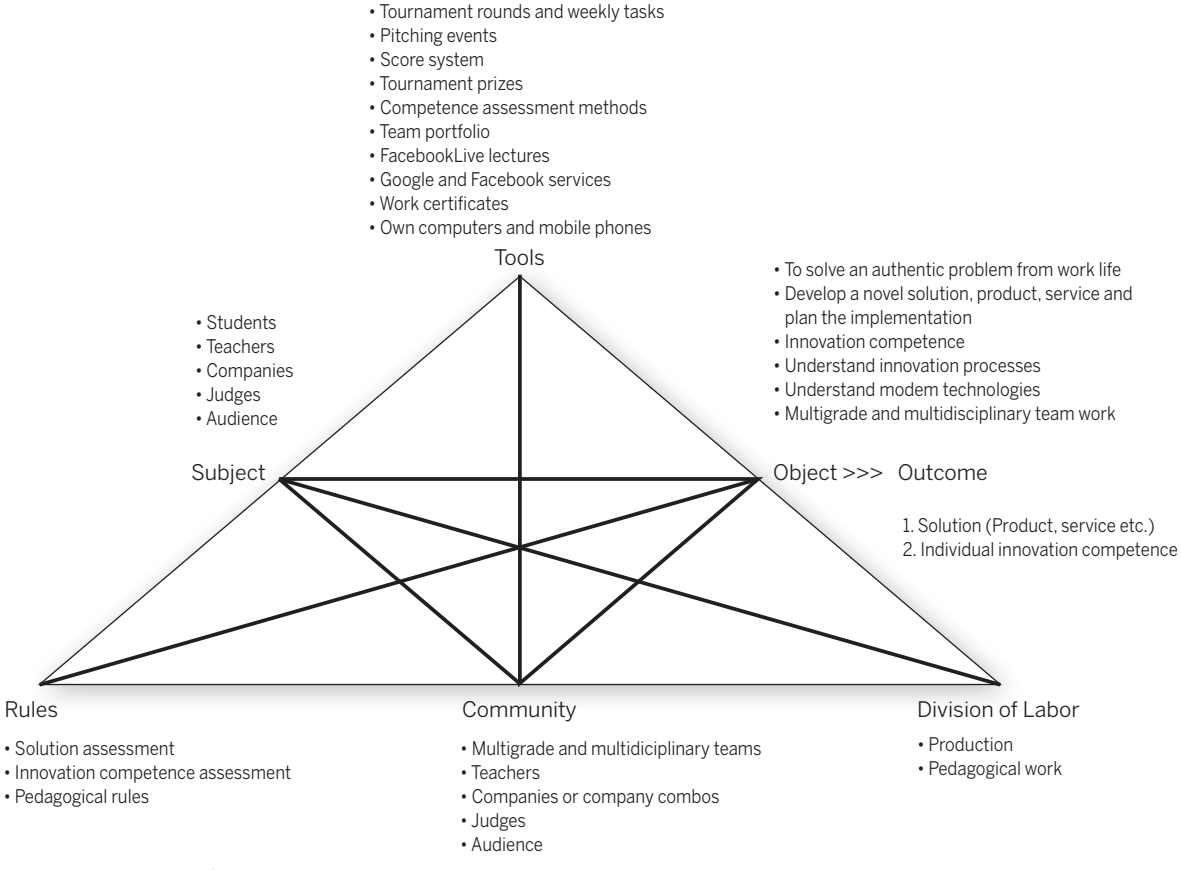

Figure 3. Innovation tournament activity system (Teacher Forums I–VII) (Adapted from Engeström, 1987, 2014)

The optimal pedagogical innovation process as a tournament for this context was designed to be an authentic task-based learning environment following the innovation process. In this process, collaboratively created ideas are transformed into a concrete end-result, prototyped and tested, and implemented to convey value in the surrounding world through interactions in a networked community. In conclusion, for the purposes of learning, an innovation tournament cannot aim at the creation of a new product or service, only idea development, which is what short innovation tournaments generally do (e.g. Duverger & Hassan, 2007). In formal education, an innovation tournament can possibly be organised in weekly rounds to unfold the innovation process phases individually. Doing so can increase understanding of the innovation processes for later application in working life.

According to the participating teachers, learning subject (Engeström, 1999) in a pedagogical innovation process is not only a single student but a networked multidisciplinary and multi-grade team. This was considered an authentic way of working. The needed stakeholders constituting the community with the students were judges who boost entrepreneurship and competence development, committed firms as weekly coaches, teacher pairs (one from a secondary institution and another from a tertiary vocational institution), older student tutors with their own specialisation, a tournament producer and a tournament manager. The process-oriented learning environment requires authentic and inspiring challenges from firms and organisations, the development of a team innovation climate, peer-tutoring for translating the activity into learning during the process, new kinds of competence assessment criteria and methods, and inspiring facilities. The co-activity between secondary and tertiary vocational students in multi-disciplinary teams was found to be challenging because of the students' different levels of competence and abilities in taking responsibility independently. Still, according to the teachers involved, the team formation simulated well the team types in working life and was found to be optimal for learning for those students targeting tertiary studies later on. Competing against fellow students as a part of a mandatory curriculum was not observed as a negative endeavour.

The study found tensions and solutions in object formation concerning students in terms of tasks, assessment and ways of working; concerning teachers in terms of assessment methods, teachers' role and competence; and concerning the participating companies in terms of open and authentic challenge (i.e. task) formation and negotiation. The rules of the tournament created tension, but solutions were mostly found. The teachers separated the rules of the tournament and the pedagogical rules as a project course. The rules concerning the solution assessment criteria and the scoring system that the judges used were unclear, but these were clarified for the next pilot. Furthermore, the team competence assessment criteria and the selection of the winning team created tensions that needed solutions before the model could be planned. The tensions and solutions in the tools of the tournament were related to the process phases, the methods of choosing the winners and prizes, and the technical tools needed in the tournament. The solutions related to pedagogical tools concerned tasks, lectures and tutoring, and individual student assessment (Teacher Forums I–VII). However, most of these tensions were resolved in the multi-disciplinary collabora-

tion of teachers and the production staff. From the solutions, the development of an innovation tournament activity system framework was possible (Figure 3).

Designing the right types of activity systems can have immediate observable effects on competence development (Pant, 2012; Amabile, 1996). According to Spencer and Spencer (1993), competence always involves an intent, which is the motive or trait that incites action towards an outcome. The innovation outcome can be considered the intent for the development of competence. The findings seem to support the pre-conditions set for the design of the activity system. They seem to support the pre-requisite of innovation competence (Hero et al. 2017, see also Avvisati et al., 2013; Arvanitis & Stucki, 2012; Bjornali & Støren, 2012; Bruton, 2011; Chatenier et al., 2010; Chell & Althayde, 2011; Edwards-Sachter et. al., 2015; Montani et al., 2014; Nielsen, 2015; Santandreu-Mascarell et al., 2013; Vila et al., 2014; Wang & Shuai, 2013; Waychal et al., 2011) as the outcome of the tournament. Teachers found the competence development objective to be needed as in the institutional context; the main goal is learning during the process and not just developing a successful solution for the company partner. As a conclusion from the teacher forums, multi-disciplinary and multi-grade team formation can support the development of social skills and flexibility. Competition in the tournament can support achievement orientation. Furthermore, authentic and open challenges from real working life potentially promote motivation and engagement. Success in competition and being a part of a competent team may support self-esteem. Finally, the diversity of team members may promote the self-management of students.

The activity system was organised in seven weekly rounds with weekly tasks: the orientation (future, innovation concept), idea, concept, prototype and testing, implementation, entrepreneurship and assessment rounds. The design of the rounds enabled the development of innovation competence (Hero et al., 2017): future orientation in the orientation round, creative thinking skills in the idea round, project management skills in the project-based way of working in the team, content knowledge in the idea and concept rounds, and making skills in the prototype and testing round. The community was organised to support the creation of the vision, to facilitate idea generation and to foster the creation of new solutions to authentic problems. It also allows social interaction in the form of team projects to incorporate project management activities. Moreover, the activity system allows the design of useful solutions. Multi-disciplinary team formation enables multiple perspectives, skill variety as complementarity of knowledge (Miettinen & Lehenkari, 2016; O'Reilly et al., 1998; Hakkarainen et al., 2004) and new knowledge interfaces, whilst introducing students also to other disciplines.

The strength of this study is that it gives an upper-level overview of the multidisciplinary tournament activity system designed by the teachers. This overview is usable in practice for the design of similar tournaments in vocational and higher education contexts. This system can also be applied in other project-based learning contexts, as it clarifies the relation of innovation competence and the pedagogical process that aims at novel solutions for working life. A weakness of the study is the inadequate types of research materials analysed for triangulation to design a universally reliable activity system mod-

el. This case study reports only the findings of the development of two Finnish tournament pilots. The system was designed only from the teachers' perspective and only in a multi-disciplinary and multi-grade team context.

Several limitations should be carefully considered before applying the results of this research. The first one is that the research materials were limited. Only two pilot tournaments were designed based on the teacher workshops. The second limitation is that although we used a systematic approach to collect the video material and applied a transparent analysis process, other researchers may identify other tensions and solutions in the discussions. However, this view is arguably true for most video annotations when only one annotator is involved (Derry et al., 2010).

The study has practical implications for authentic project-based pedagogy. The findings can be applied when planning innovation tournaments in vocational and higher education contexts. The activity system model can be applied when designing similar types of learning environments. Future research agenda can focus on objectives, tools and rules from student and company perspectives. Although the selected innovation competence criteria (Hero et al., 2017) was found to be applicable and comprehensive, the assessment methods based on it require further research. The self-assessment surveys were not found to be reliable methods in the tournament context. It is not possible to discover the usefulness of innovation tournament in developing innovation competence unless it is possible to, at reasonable certainty, assess the competence development. Novel types of assessment tools are thus needed. The role of the teacher and peer-tutoring within the multi-disciplinary team would likewise benefit from future research to understand how innovation can best be facilitated.

References

Adamczyk, S., Bullinger, A. C., & Möslein, K. M. (2012). Innovation contests: A review, classification and outlook. *Creativity and Innovation Management*, *21*(4), 335–360.

Amabile, T. M. (1996). *Creativity in context: Update to the social psychology of creativity.* Boulder, CO: Westview Press.

Arvanitis, S., & Stucki, T. (2012). What determines the innovation capability of firm founders? *Industrial and Corporate Change*, *21*(4), 1049–1084.

Bjornali, E. S., & Støren, L. A. (2012). Examining competence factors that encourage innovative behaviour by European higher education graduate professionals. *Journal of Small Business and Enterprise Development*, *19*(3), 402–423.

Baregheh, A., Rowley, J., & Sambrook, S. (2009). Towards a multidisciplinary definition of innovation. *Management Decision*, *47*(8), 1323–1339.

Boudreau, K. J., Lacetera, N., & Lakhani, K. R. (2011). Incentives and problem uncertainty in innovation contests: An empirical analysis. *Management Science*, *57*(5), 843–863.

Bruton, D. (2011). Learning creativity and design for innovation. *International Journal of Technology and Design Education*, *21*(3), 321–333.

Chatenier, E. D., Verstegen, J. M., Biemans, H. A., Mulder, M., & Omta, O. F. (2010). Identification of competencies for professionals in open innovation teams. *R&D Management*, *40*(3), 271–280.

Chell, E., & Athayde, R. (2011). Planning for uncertainty: Soft skills, hard skills and innovation. *Reflective Practice*, *12*(5), 615–628.

Chi, M. (1997). Quantifying qualitative analyses of verbal data: A practical guide. *Journal of the Learning Sciences*, *6*(3), 271–315.

Derry, S. J., Pea, R., Barron, B., Engle, R., Erickson, F., Goldman, R., … & Sherin, B. (2010). Conducting video research in the learning sciences: Guidance on selection, analysis, technology, and ethics. *Journal of the Learning Sciences*, *19*(1), 1–51.

Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal*, *34*(1), 555–90.

Dougherty, D. (1992). A practice-centered model of organizational renewal through product innovation. *Strategic Management Journal*, *13*(1), 77–92.

Duverger, P., & Hassan, S. (2007). An empirical study to identify new sources of radical service innovation ideas using the toolkit for idea competition. *Proceedings of The World Conference on Mass Customization and Personalization (MCPC 2007)*. Boston: MIT.

Edwards-Schachter, M., García-Granero, A., Sánchez-Barrioluengo, M., Quesada-Pineda, H., & Amara, N. (2015). Disentangling competences: Interrelationships on creativity, innovation and entrepreneurship. *Thinking Skills and Creativity*, *16*, 27–39.

Elan. (2017). *Elan download and demo.* The Language Archive. Max Planck Institute for Psycholinguistics. Retrieved from https://tla.mpi.nl/tools/tla-tools/elan/

Engeström, Y. (1987). *Learning by expanding: An activity theoretical approach to developmental research.* Helsinki: Orienta-Konsultit Oy.

Engeström, Y. (1999). Innovative learning in work teams: Analyzing cycles of knowledge creation in practice. In Y. Engeström, R. Miettinen, & R.-L. Punamaki (Eds.), *Perspectives on activity theory* (pp. 377–404). Cambridge, UK: Cambridge University Press.

Engeström, Y. (2014). *Learning by expanding: An activity-theoretical approach to developmental research.* Cambridge, UK: Cambridge University Press.

Erickson, F. (2006). Definition and analysis of data from videotape: Some research procedures and their rationales. In J. L. Green, G. Camilli, & P. B. Elmore (Eds.), *Handbook of complementary methods in education researc*h (pp. 177–205). Mahwah, NJ: Erlbaum.

European Commission. (2017). Communication from the commission to the European parliament, the Council, the European economic and social committee and the Committee of the regions on a renewed EU agenda for higher education. Retrieved from https://ec.europa.eu/education/sites/education/files/he-com-2017-247_en.pdf

European Commission. (2012). Rethinking education: Investing in skills for better socio-economic outcomes. Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0669&from=FR

Eveleens, C. (2010). Innovation management: A literature review of innovation process models and their implications. *Science*, *800*(2010), 900.

Füller, J. (2006). Why consumers engage in virtual new product developments initiated by producers. *Advances in Consumer Research*, *33*(1), 639–646.

Glesne, C. (2005). *Becoming qualitative researchers: An introduction* (3rd ed.). Boston: Allyn & Bacon.

Hakkarainen, K., Palonen, T., Paavola, S., & Lehtinen, E. (2004). *Communities of networked expertise: Professional and educational perspectives*. Amsterdam: Elsevier.

Hero, L.-M., Lindfors, E. & Taatila, V. (2017). Individual Innovation Competence: A Systematic Review and Future Research Agenda. *International Journal of Higher Education*, *6*(5), 103-121.

Jonassen, D. H., & Rohrer-Murphy, L. (1999). Activity theory as a framework for designing constructivist learning environments. *Educational Technology Research and Development*, *47*(1), 61–79.

Kay, L. (2011). The effect of inducement prizes on innovation: Evidence from the Ansari X Prize and the Northrop Grumman Lunar Lander Challenge. *R&D Management*, *41*(4), 360–377.

Konst, T., & Jagiello-Rusilowski, A. (2017). Students' and Higher Education stakeholders' concepts of resilience in the context of innovation camps. *Adult Education Discourses, 18*, 19–32.

Krippendorff, K. (2013). *Content analysis: An introduction to its methodology* (3rd ed.). California: Sage Publications.

Leton, D. A., & Anderson, H. E. Jr. (1964). Discriminant analysis of achievement characteristics for multi-grade grouping of students. *The Journal of Experimental Education*, *32*(3), 293–297.

Lindfors, E., & Hilmola, A. (2016). Innovation learning in comprehensive education? *International Journal of Technology and Design Education*, *26*(3), 373–389.

Marin-Garcia, J. A., Andreu Andres, M. A., Atares-Huerta, L., Aznar-Mas, L. E., Garcia-Carbonell, A., González-Ladrón-de-Guevara, F., Montero-Fleta, B., Perez-Peñalver, M. J., & Watts, F. (2016). Proposal of a Framework for Innovation Competencies Development and Assessment (FINCODA). *Working papers on operations management (WPOM), 7*(2), 119–126.

Malhotra, A., & Majchrzak, A. (2014). Managing crowds in innovation challenges. *California Management Review*, *56*(4), 103–123.

Marcus, A. A. (1988). Responses to externally induced innovation: Their effects on organizational performance. *Strategic Management Journal*, *9*(4), 387–402.

Miettinen, R., & Lehenkari, J. (2016). Encounters and extended collaborative creativity: Mobilization of cultural resources in the development of a functional food product. In V. P. Glaveanu (Ed.), *The Palgrave handbook of creativity and culture research* (pp. 263–283). UK: Palgrave Macmillan UK.

Miller, B. A. (1991). A review of the qualitative research on multigrade instruction. *Proceedings from*

Reaching Our Potential: Rural Education in the 90's, Rural Education Symposium. Nashville, TN: Rural Education Symposium.

Montani, F., Odoardi, C., & Battistelli, A. (2014). Individual and contextual determinants of innovative work behaviour: Proactive goal generation matters. *Journal of Occupational and Organisational Psychology*, *87*(4), 645–670.

Morgan, J., & Wang R. (2010). Tournament for ideas. *California Management Review*, *52*(2), 77–97.

Nardi, B. A. (1996). Studying context: A comparison of activity theory, situated action models, and distributed cognition. In B. A. Nardi (Ed.), *Context and consciousness: Activity theory and human-computer interaction* (35–42). Cambridge, MA: MIT Press.

Nielsen, J. A. (2015). Assessment of innovation competency: A thematic analysis of upper secondary school teachers' talk. *Journal of Educational Research*, *108*(4), 318–330.

O'Reilly, C., Williams, K., & Barsade, S. (1998). Group demography and innovation: Does diversity help? In D. H. Gruenfeld (Ed.), *Composition: Research on managing groups and teams* (pp. 183–207). Stamford, CT: JAI.

Pant, L. P. (2012). Learning and innovation competence in agricultural and rural development. *Journal of Agricultural Education and Extension*, *18*(3), 205–230.

Passaro, R., Quinto, I., & Thomas, A. (2017). Start-up competitions as learning environment to foster the entrepreneurial process. *International Journal of Entrepreneurial Behavior & Research, 23*(3), 426–445.

Pedersen, J., Kocsis, D., Tripathi, A., Tarrell, A., Weerakoon, A., Tahmasbi, N., … & De Vreede, G.-J. (2013). Conceptual foundations of crowdsourcing: A review of IS research. *46th Hawaii International Conference on System Sciences (HICSS).* HI, USA: IEEE.

Rautkorpi, T., & Hero, L.-M. (2017). Promoting students' reflections in organisational improvisation arrangement between higher education and workplaces. *Nordic Journal of Vocational Education and Training*, *7*(1), 1–22.

Santandreu-Mascarell, C., Garzon, D., & Knorr, H. (2013). Entrepreneurial and innovative competences, are they the same? *Management Decision*, *51*(5), 1084–1095.

Sawyer, R. K. (2006). Educating for innovation. *Thinking Skills and Creativity*, *1*(1), 41–48. doi:10.1016/j.tsc.2005.08.001.

Sawyer, R. K. (2014). The future of learning: Grounding educational innovation in the learning sciences. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (2nd ed.) (pp. 726–746). Cambridge: Cambridge University Press.

Schumpeter, J. A. (1942). *Capitalism, socialism, and democracy.* New York: Harper.

Scott P., Schaffer, S. P., Reyes, L., Kim, H., & Collins, B. (2010). Using activity theory to understand learning design requirements of patient self-management environments. *Educational Media International*, *47*(4), pp. 329–342.

Sloep, P. B., Berlanga, A. J., & Retalis, S. (2014). Introduction to the special issue on Web-2.0 technologies in support of team-based learning for innovation. *Computers in Human Behavior*, *37*(1), 342–345.

Sloetjes, H., & Wittenburg, P. (2008). Annotation by category – ELAN and ISO DCR. *Proceedings of the 6th International Conference on Language Resources and Evaluation (LREC 2008)*. Morocco: ELRA.

Spencer, L., & Spencer, S. (1993). *Competence at work: Models for superior performance.* New York: John Wiley & Sons.

Taatila, V., Suomala, J., Siltala, R., & Keskinen, S. (2006). Framework to study the social innovation networks. *European Journal of Innovation Management, 9*(3), 312–326.

Terwiesch, C., & Xu, Y. (2008). Innovation contests, open innovation, and multiagent problem solving. *Management Science*, *54*(9), 1529–1543.

Van Der Vegt, G., & Bunderson, J. (2005). Learning and performance in multidisciplinary teams: The importance of collective team identification. *Academy of Management Journal* 2005, *48*(3), 532–547.

Vila, L. E., Pérez, P. J., & Coll-Serrano, V. (2014). Innovation at the workplace: Do professional competencies matter? *Journal of Business Research, 67*(5), 752–757.

Wang, D., & Shuai, C. (2013). Does intellectual capital matter? High-performance work systems and bilateral innovative capabilities. *International Journal of Manpower*, *34*(8), 861–879.

Wass, R., & Golding, C. (2014). Sharpening a tool for teaching: the zone of proximal development. *Teaching in Higher Education*, *19*(6), 671-684.

Waychal, P., Mohanty, R., & Verma, A. (2011). Determinants of innovation as a competence: An empirical study. *International Journal of Business Innovation and Research*, *5*(2), 192–211.

Yamagata-Lynch, L. C. (2010). *Activity systems analysis methods.* LLC: Springer Science+Business Media.