Work-Integrated Learning and Co-creation of Knowledge

- **Design of collaborative technology enhanced learning activities**

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Abstract. In this paper we aim to understand management's perceptions of knowledge and competence development to inform the design of technology enhanced learning activities integrated in the workplace. Work-integrated learning can be viewed with the university lens on studies of formal education integrated in the workplace setting, but here we rather emphasize the conditions of the workplace as implications for design of successful e-learning initiatives. We conducted interviews with 15 manufacturing industries in Sweden and used qualitative content analysis approach to interpret the text data. Results show that companies describe a rich variation of work-integrated learning activities, but the step towards external collaboration with academia for co-production of knowledge is marginal. Also, broad-minded work for innovations is limited. This imply the need for well-planned design of richer collaborative acitivites between academia and organizations through use of media technology to encourage competence development.

Keywords: technology enhanced learning (TEL), work-integrated learning, co-creation, manufacturing industry

1 Introduction

Digitalization in higher education causes a rapid development of media technology to meet the needs of learners in- and outside the university (Drlik and Skalka, 2011). From a student perspective media technologies such as learning management systems (LMS), e-learning platforms, web conference systems, cloud applications etc. aims to support successful learning outcome independent of time- and space (Kahiigi et al., 2008; Simões, 2013; Singh, 2000). Teachers' knowledge base and skills for content production of lectures through for instance film production and streaming media are also debated in research (Govindasamy, 2001; Drlik and Skalka, 2011; Mishra and Koehler, 2006). Accordingly, many research studies are focused on the teacher and student interaction in educational settings and have generally ignored the workplace as a context for intentional and organized technology enhanced learning (TEL) activities. Since learning activities are integrated in the workplace, other conditions can cause dilemmas in the work organization as management support, learning culture, technology maturity and social interactions (Lahn, 2004; Michalski, 2013). A more complex understanding

of the learning context should therefore carefully be considered since TEL initiatives are integrated into the workplace (Boud et al., 2003; Cheng Y.M., 2011; Fuller et al., 2007; Govindasamy, 2001; Lahn, 2004; Michalski, 2013; Servage, 2005; Tavangarian et al., 2004). Godvindasamany (2001) claim the importance of not handling employees as regular students since learning is strategically of interest for the organization, *"…the imperative today is not the mere access to knowledge, but timely access to relevant and useful knowledge. The real value of e-Learning lies not in its ability to train just anyone, anytime, anywhere, but in our ability to deploy this attribute to train the right people to gain the right skills or knowledge at the right time."* (Godvindasamy, 2001).

With a TEL approach in the manufacturing industry as the learning organization, we would argue for a wider knowledge view of the workplace before designing competence development initiatives. Today there is a lack of extensive research specifically directed towards the conditions for workplace learning mediated by learning technologies and interactive media (Michalski, 2014). Consequently, the fact that technology enhanced competence development is utilised in workplace settings, brings to front that these aspects must also be researched in context of the workplace in general, and the manufacturing industry in particular. To unpack the notion of this learning environment and get an inside view of the learning conditions may support expert engineers to develop new knowledge and become more efficient, in contribution to innovations. With focus on engineering work we acknowledge learning as situated and as a social negotiation process for strengthening meaningful work practices (Hotho et al., 2014; Lave and Wenger, 1991; Lea and Nicoll, 2013).

In this paper we are concerned with industry management´s perception of learning in the workplace, and how co-production of knowledge is expressed in words and actions. The aim is to identify management´s view on knowledge work and learning processes that will inform the design of a model for TEL collaborative learning activities. We argue for a model as implication for design of learning activities that will facilitate collaborative TEL as work-integrated learning (WIL). In this paper a case study of production managers and human resource managers is the knowledge base to exemplify and develop this model. The question is:

How can our understanding of managements´ perceptions of knowledge and competence development inform the design of TEL activities?

1.1 MERIT project

Through an initial case study of 15 manufacturing companies located in the western part of Sweden we explore the conditions for competence development in collaboration with a university and a network of collaborators. The case study is part of the two year (2013-2015) project MERIT. The project aims is to design and offer TEL courses on post graduate level with knowledge content that are co-created between higher education and the manufacturing industries. MERIT is a collaborative venture between University West (UW), located in the west of Sweden and interested partner companies in the manufacturing industries in this region. Also representatives from the Innovatum Technology Park and from the Industrial Development Centre (an institute for support of manufacturing companies, SME´s) is part of the collaboration. At UW, the project group of six researchers in engineering, two in informatics and one in computer science located at the Production Technology Centre (as part of UW) also conduct collaborative research within production technology with some of the companies.

The collaborative activities is created in a network, where the companies can participate in meetings and/or courses due to time and focus of interest. Production managers and HR managers join MERIT meetings regularly for discussions about competence development in relation to strategically production goals in their own manufacturing plants. Courses that are developed are supposed to be adjusted to company knowledge needs and implemented in flexible forms, i.e. as TEL courses.

The knowledge content is in industrial automation, virtual manufacturing and robotics as well as in applied simulation of manufacturing processes. Specific topics within these areas will co-produced through collaborative activities between the participating organizations. Up till now one course (of two ECTS) in industrial automation is running on-line to allow employees' to learn in more flexible forms than before. Also, in an earlier analysis of the case study, organizational e-learning readiness was presented in a framework of constructs in relation to participating companies (Hattinger, 2014).

2 Theoretical framework

Production technology is an interdisciplinary field and presents a wide area of knowledge employees in the industry are stressed to accomplish. Knowledge work within in this field is multifaceted and both expert knowledge and general know how is necessary. Effective industrial work also emphasizes capabilities to handle knowledge divers. Knowledge is of various kind, within humans and within machines and technology, and thus advanced expert knowledge in engineering work, can mostly be explained as systematic comparison undertaken for various reasons (Burke, 2012).

An increasingly important part in engineering sciences such as production technology is knowledge of concurrent and complex phenomenon and also about development of industrial modelling and simulation. The techniques and the skills required to master the underlying theories are often limited in the industry, while experience-based expertise and practical skills are often high. Collaboration between different professions and skills in the production chain can reinforce knowledge development but conditions for this collaboration can also be understood from different angles (Richey et al., 2009). Accordingly, when companies are performing challenging tasks inter-firm collaboration is not always a feasible solution due to inherent risks of bringing out valuable knowledge. Instead they suggest that knowledge can be found internally through use of different supportive technologies as e-learning tools as well as enterprise resource planning systems or alike. Though in this paper, we believe that interaction between academia and a network of industries have a potential for a joint collaboration where both parties together co-produce knowledge content for expertise and innovation.

2.1 Work-integrated learning

Work-integrated learning (WIL) is typically described as a combination of education and practice in the workplace. Learning is described as activities in the workplace environments in which knowing and learning are co-constructed through ongoing and reciprocal processes (Billet, 2001). WIL has the potential of providing direct and significant benefits for students, workplaces, universities, and in turn, a wider community. Learning integrated in the workplace can be built on practical tasks and work situations with the aim to serve organizational goals. Recently, attention to workplace learning (or work-integrated learning, here used as synonyms)

has greatly increased due to the significant role of professional skills and expertise in organizational development. Moreover, workplace e-learning or web-based training is being studied by a significant number of groups (Wang et al. 2010).

Engeström and Kerosuo (2007) as well as Ellström (2001) discuss the classical divide of workplace learning and organizational learning. Engeström describe the workplace learning as an extension of educational research but goes beyond the confines of schools as formal learning, though workplace learning is originally stemming from pedagogical schools. Organizational learning on the other hand, has emerged as a sub-field of organization and management studies. Usually organizational studies are driven by management strategies with the underlying assumption of effectiveness and result orientation. *"The divide between workplace learning and organizational learning has resemblances to the classic divides between micro and macro, between agency and structure."* (p. 336, Engeström). He suggests use of activity theory to transcend boundaries and for us to understand local changes and actions in relation to levels above and between objects.

Ellström (2001) also problematize the consensus of former research claiming that work-based learning is enhancing productivity, innovation and competitiveness, as economic considerations, *"little is known about processes of learning at work and the conditions that are likely to facilitate or constrain such processes importance of these efforts"* (p. 422, Ellström, 2001). identifies five groups of important factors for workplace learning: 1) the task, variety and possibilities to control, 2) opportunities for feedback, evaluation and reflection, 3) the degree of formalization of the labour process, 4) the degree to which people are involved in the problem management and development and 5) the time for analysis, interaction with others and reflection. Here these five groups are applied to the roles in focus.

Illeris (2003) means that there is an urgent need to establish interaction between workplace learning and educational interaction. He has to some extent a scholastic view of workplace learning, when he discusses adult learning and vocational training in relation to workplaces. He also dispute organizational learning in favour of individual learning; *"the learning organisation, is thus a misnomer, a kind of verbal theft, as organisations do not have and cannot develop such qualities."*(p.169), instead learning is something that happens within individuals and not a management issue. He suggests a contemporary and comprehensive learning theory building on individual cognitive thoughts, where the skill or knowledge content is learned and stored in internal schemas.

Döös and Wilhelmsson (2011) also bring in the importance of networking across both on internal and external organizational levels for widening the concept of workplace learning within expert-oriented companies as Ericsson and claim that knowledge creation is context-dependent. Other studies within company settings also show that organizations differ in the way they manage and create themselves as learning environments (Fuller et al., 2007)**.**

2.2 Technology enhanced learning (e-learning)

Digital tools as interactive technology, is supposed to enhance collaboration and communication and has to some level changed the behavior of us humans as social individuals, and is consequently affecting our workplaces and working conditions (Taras et al., 2004). Within company organizations e-learning is described as the tool for enhancing learning E-learning based on distance education and implemented with advanced information technology.

It has been described as the use of telecommunication technology to deliver, support and enhance learning (Violanete and Vezzetti, 2012).

So questions arise to what extent digital learning tools can support learning and how both learning content and plat forms are to be designed and used. Studies show that ICT-learning initiatives within educational contexts are easier to make successful (Beldarrain, 2006) than in other contexts. In the workplace there are other conditions that can make dilemmas (Govindasamy, 2001; Lahn, 2004). Lahn (2004) describe three categories of dilemmas in relation to an e-learning project; dilemmas (1) in the work organization, (2) in the user interface and (3) in the system development process. Consequently, there is a gap between visions of net-based learning in the workplace and what was realistic to flourish at the time of implementation and use in a real working situation. Also, e-learning is common in the manufacturing industry, and often as technology that deliver knowledge content for individual learning. Though these e-learning systems do not always succeed in real problem solving and learning. Accordingly these kind of e-learning systems can be described as digital learning material and not organised in a didactical learning situation with other learners and teachers. The interaction for the user/learner is the program instead of practitioner´s or experts within the organization or in other network organizations. Other authors also argument for the benefits with e-learning, but also raise concern of failing if we do not plan ahead. Schreurs and Al-Huneidi (2012) emphasize the need to assess the readiness in organizations for adoption of e-learning initiatives. Servage (2005) also discusses the blurring e-learning initiatives and points to the huge investments in e-learning that cause's trouble with economy and fast time learning instead of focusing on ICT-learning initiatives building on real workplace needs.

3 Methodology

Research in the interface between learning and work practices advocate a critical approach to get deeper understanding of the study object. Walsham (2006) recommend that we should choose research approaches and methods that are insightful for the research settings which builds on the interpretation of the work. This paper reports on results from of a longitudinal case study that is an accepted approach within information system research (Cavaye, 1996; Klein and Myers, 1999; Bryman, 2012). Case study research in a broad sense study phenomena in its natural context, usually to get deep understanding by using qualitative techniques for data collection and analysis (but the tradition also favor quantitative techniques, see for example Lee, 1989 and Yin, 1989). The term case can be associated with a location or an organization, but also as a typical case where the objective is to capture the circumstances and conditions of an everyday or commonplace situation (Yin 2009: 48).

The research approach chosen here is a longitudinal case study consisting of three cases; initial study, implementation study and evaluation study and this paper is part of the first one about *management's knowledge view of their organizations for participation in TEL activities integrated in the workplace.* We have used semi-structured interviews and meeting notes as main data sources (qualitative data). To interpret the data qualitative content analysis was used as an inductive approach. The content were then coded into categories.

3.1 Interviews

To identify management's knowledge view and competence activities in the organizations, data was collected through semi-structured interviews with manufacturing companies. Initially we invited a broad sample of known companies, mainly selected from University Wests contact database, to participate in the MERIT project and for an interview session. 15 companies responded to an interview session during 2013.

The collected empirical data consists of 16 interviews with 15 companies, in one company, two interview sessions took part. The target informants were the top level production manager (or plant manager) and the top human resource managers, who were interviewed simultaneously for about one and a half to two hours sessions. In total 27 informants participated for around 20 hours' time. In some companies only the production manager or the CEO participated due to time limitation. The sessions were set up as an informal meeting and led by two researchers. The discussions were open and directed by the themes in the interview guide to make the informants commit their knowledge view on competence work in relation to organization strategies and innovative goals. Also discussions about expert knowledge and critical production processes took place.

The semi-structured interview guide was sent out to the informants one week before the interview sessions. All interviews were conducted under a period of six month, spring, 2013, and in this time they were audio recorded and transcribed continuously by one researcher in the research team. Five themes with sub questions were covered in the guide as follows; 1) Basic company facts of education levels and internal competence work, 2) Competence need, i.e. content knowledge including expert knowledge, 3) Experience of IT use for competence development and available e-learning systems, 4) Knowledge and learning as strategy for innovation and 5) External collaboration and co-production of knowledge. They covered individual and organizational levels, and also internal and external relations.

Results covering all themes on an overall level and especially within theme 1-3 have recently been published (Hattinger, 2014). In this paper we are analyzing *theme four and five.* Questions in theme four were formulated as: *How do you discuss relations between individual competences, effectiveness and innovations on management levels? How is organizational learning described and/or discussed?* Questions in theme five were formulated as: *How do you view and value collaboration with higher education for co-production of master education tailored from your competence needs? How can we organize such initiative?*

3.2 Analysis

Qualitative content analysis was used to interpret the text data as an inductive approach (Bryman 2012; Kohlbacher 2006). This method is useful when the boundaries between phenomenon and context are not clearly evident in case study research (Kohlbacher 2006). Through a systematic classification process of coding and identifying themes we can identify patterns of behavior and situations as a process rather than outcome in relation to the research question (Kohlbacher 2006).

Table 1 summarizes some of the basic characteristics of the companies that participated in the study. Thereafter we conducted an iterative and thematic approach and found categories mainly developed from the interpretation of the managers' perceptions of knowledge work and attitudes to learning in the workplace. By reading through the text we analysed uncovered expressions in words and described activities as part of how professional development in the

organization is treated. Then, the analysed phrases, were coded into condensed references by using the computer qualitative data analysis software (SQDAS) NVivo 10. Examples of condensed references are: “critical and functional competences is discussed”; “discuss changes and how to grasp ideas as a process to be innovative”; and “continually write the competence plan together with academia”. They represent compressed references that summarizes key phrases among selected quotations. These references were then combined into general nodes. Continually the coding process were discussed within the research group. Altogether ten nodes were defined and resulted into two main categories representing different perspectives in the data, see table 2 in the next section. During the analysis we also tried other techniques as queries for coding word frequency, and found the most common words, e.g. competence (and similar), learning, education, co-production, collaboration/co-work, expert competence, web meetings, technology use, network and change. But this analysis process did not add any deeper valuable insight into the results more than giving a hint on what words the informants used.

3.2.1 Basic facts of the manufacturing industries

Ten of 15 companies are international corporate industries and the other five have factory plants and/or retail offices in the Scandinavian countries. All of the 15 companies have a production plant or an office in the western part of Sweden. A categorization of the companies in terms of number of employees, number of university-educated employees, type of industry, local or global industry and their own R&D department are presented in table 1.

Facts	***Firm type/nr of firms***
Nr of employees in the manufacturing plants	In the 15 firms a total of approx. 7 200. Two firms with approx. 2 000 (one in aerospace and one in automotive) Two firms with approx. 500 Ten firms with approx. 130-300 One firm with 26
Nr of engineers with an academic degree	In the 15 firms a total of 950, among these approx. 430 are employed by the largest aerospace industry
Branch of industry	Three in aerospace Six in automotive Three in consulting (in both aerospace and automotive) One in medicine Two in other areas
Local or global industry	Ten international corporate firms Three Scandinavian firms Two Swedish firms
Own R&D department	Seven companies

Table 1. Basic facts of the manufacturing industries

4 Results

The comprised result is presented in table 2 below and include coded references categorized into nodes and then divided into the categories WIL and Co-production of knowledge. Below the table, there is a description of the nodes and some related examples of quotations.

Coded references	*Nodes*	*Category*
Sometimes we discuss it in the business plan No strategic competence plan Every production manager can do more Frequent discussion on how to be a better organisation (high level) Through project management and control Swot analysis Top management do it regularly as our business goal (OEM) Critical and functional competences is discussed To close the GAP:s in the analysis	**WIL – BUSINESS STRATEGY**	**WIL**
Must work more organised now when our target is to grow 5 % in the corporte group Discuss changes and how to grasp ideas as a process to be innovative To find a critical process and do a customer value added analysis Try to describe a platform, i.e. a map for innovations Leadership as change management	**WIL – CHANGE PROCESSES AND INNOVATION**	
Only talk about learning of the whole organisation at the head quarter in Sweden (low level) We move around people to develop learning in the organisation Internal quality revisions, FMEA More described as effective learning, how we use learning in the organisation more than innovation	**WIL – ORGANISATIONAL LEARNING -**	
Finding right competences to find right products Tough situation with the crises before, 150 employees were fired, now we are equal effective with less employed Individual competences and effectiveness but not as a focus area Learning by doing all the time Three parts among the employees: learning, flexibility and development efforts We need expert knowledge in the production plant (GKN?)	**WIL – INFORMAL LEARNING**	
Much ”Lean” education helps us to think in processes Hard to find right competences in Electric engineering and product development We do it internally built on the students basic work Yearly conferences “technology management”, training days, mentorship Learning in flexible modes are good	**WIL- FORMAL LEARNING AND EDUCATIONAL DESIGN**	
Want to be in the technology lead within our product segment, but is still struggling Our system “XXX” for FMEA is our body of knowledge Different systems for learning support, but ends up in the materialistic view CV database that we chair internally	**WIL- TECHNOLOGY USE**	
Many Co-op students, several ongoing every year High school students visit manufacturing plants as long-term recruitment Finance lego robots Through thesis work (bachlor level) we have raised our turn over with XXX XXX SEK Bachelor/Master thesis PhD students	**CO-PRODUCTION STUDENT COLLABORATION**	CO-PRODUC-TION

Should have more relations and develop courses together Most important is how CEO and top management view collaborative development Have a practical view on production technology – high school level We must describe our own plan to promote co-production between cross-funtional work To participate as one actor among others is possible in limited boundaries Development projects and lectures can be placed here at our production plant Future trainee on master level Write the competence plan together with academia continually Do not know what academia can provide	**CO-PRODUCTION – HIGHER EDUCATION**	CO-PRODUC-TION

Table 2. Described knowledge views and learning activities

4.1 Work-Integrated Learning - WIL

This category gave comprehensive perspectives on work-integrated learning in practice and therefore the sub-nodes are explained according to the interpretation of these nodes. We have provided brief descriptions of the nodes from the statements of the informants.

4.1.1 WIL as business strategy

This node refers to structural and goal oriented competence work that is aligned to strategic business goals and internal planning work.

There is a variation of how much work they do strategically. Only two companies described a well-founded structure for competence work internally from bottom to the highest management level. Some meant that the corporate group deals with it, and that they do not have fully insight to it, i.e. companies of size 100-300 employees.

"We are growing… we are the second-largest company worldwide on gas turbines, but do too little work with competence strategies in this unit here…" (Siemens)

4.1.2 WIL as strategic change process and innovation

This node refers to a process oriented view on how competence and learning are aligned with many of the internal processes where changes are emphasized positively.

Only a few informants gave descriptions of such activities and mostly those with the highest level of academic educated personnel. Process work for innovations were really hard to describe and some informants passed over this question with an excuse.

"… we do not discuss expertise and innovation naturally, I mean what we use the competences for, that we might NOT talk about in that way, rather more about how effective learning we did, as a more reproductive way of learning…"

4.1.3 WIL as organisationl learning

This node refers to learning activities as organised and structured from a top management perspective.

Quality work, Lean implementation and IT system support were explained as organisational learning activities. The companies with low level of academic personal also excused themselves for not thinking of learning in the whole organisation.

"… difficult to get the right staff in production, to weld … on the other hand, we are not talking so much about organizational learning. We talk future, but not stand-alone about competence skills needed in relation to the development"

4.1.4 WIL as informal learning

This node refers to learning integrated in the workplace, not formalised, but rather discursive and cultural. The creativity among the informants were vibrant. Some were visionary, others more concrete. Though we noticed that many statements developed during their talk, as they were setting words on their own thought of the internal work processes. This node have close relationship with the node of WIL and change processes, meaning that the informants that defined change processes also had more colourful ideas of informal learning.
The newly hired CEO says; "…it is 'learning by doing', that precisely, to make small evolutionary step that makes you really understand ... it can be divided into three parts - learning, flexibility, willingness to grow throughout the management team and the organization."

4.1.5 WIL as formal learning and educational design

This node refers to formal education/courses, design in various forms and conducted from the competence needs.

Informants talked with main focus on learning content. Many of the companies lack university educated personnel so competence through academic courses in flexible forms seemed to be rare. About four companies have high education level. Also descriptions of yearly conferences, course conferences and exhibitions were brought up. Pedagogical and didactical issues in relation to individual needs were rarely discussed.

"…a general education in machining where we go through sections, it can be to run a machine in practice (test)… we need to verify that for real and then do a plan, check act… we see to that it is education in both practice and theory…" (nordiska kardan)

4.1.6 WIL and technology use

This node refers to technology itself, i.e. as the production systems and e-learning systems available in the companies. This node have close relationship with the one above.

Learning about the productions system is highly motivated among all informants. They described it as the most relevant and obvious base knowledge due to survive on a concurrent market. Though companies with a tuff market, e.g. automotive branch, meant that there might be other divisions in their own global group, getting more support than themselves, due to cost and benefit measurements.

"…we use an internal system NFS for distance collaboration, mostly we use teleconference and just use web conference systems to share displays..."

4.2 Co-creation of knowledge

This category refers to collaboration outside the own company and especially collaboration with other organizations that work with research and knowledge development. Activities that support this is e.g. networking with higher education institutions through student collaboration or research.

4.2.1 CO-PRODUCTION through student collaboration

This node refers to co-production of knowledge with student collaboration through thesis work (bachelor, master and phd levels) and also through Cooperative Education (an educational program model designed with paid internship for students). When companies collaborate with University West many of them start with a student work, a bachelor thesis and increase collaboration by attaining Co-op student(s). They realize that theoretical knowledge from students are good, and that company knowledge gives them real work experience. Though for many companies this collaboration do not always level up to research collaboration, which the academia also pursue. One company, placed in the same city as UW, had for many years governed Co-op students, but had not realized or even heard about Production Technology West (PTW) as a collaborative research arena.

"…yes last year we lowered production cost with one-third by last year's theses on bachelor level. This year, we the lowered the cost of 450 000 SEK (71 000 US dollars), with the result that students have done in the spring…. I have driven these students, and I have taught them the techniques… I think it's the combination between my experience and their theoretical knowledge that has done it so successful."

4.2.2 CO-PRODUCTION through collaboration with higher education

This node refers to co-production of knowledge with other higher education and partner organizations/companies, i.e. R&D.

This is tough for all the companies since most them sort of "confess" that they don´t discuss higher education and research as collaborators for co-production of knowledge, even if they work with advanced technology. This is especially common among companies with 100-300 employees. The MERIT project is a concrete offer to collaborate on higher levels, even for companies with employees with low formal education level. Through "collaborative meetings" with UW they look forward to participate and to be part of discussions of knowledge content and find other research collaboration within production technology.

"…as competence manager I work with development on all levels… the venture must be research oriented. For 10-15 years ago we were more development oriented… now it is experts that are our entrance to qualified knowledge".

4.3 Summarized results

The earlier analysis of the case study show that all companies work well with individual competency mapping through annual development talks (Hattinger, 2014). Competence planning as an organized task is important for them but they perform and plan it with big variation. This study also showed that companies with high education level also are absorptive capacities and better e-learning maturity.

In this study, discussions of activities and perception of WIL and co-production of knowledge gave a diverse result. Low level of formal educated personnel on academic level, time and resource limitations were often highlighted. Generally the informants could describe a rich variation of work-integrated learning activities, but the step towards external collaboration with academia for co-production of knowledge were less or trivial. Also, broad-minded work for innovations were limited. Many companies are controlled by global consortium decisions and also have a low degree of external cooperation, especially the middle sized companies (100-300 employees, ten companies). Ten of 15 companies have student

collaboration on bachelor level, but only four companies conduct in research collaboration of various kind. All of them, though showed a great interest into find new forms for co-production of knowledge.

5 Contributions

In this study our preconception was that perceived management support give better understanding of the workplace conditions when competence development initiatives are designed (Cheng et al., 2012). By investigating their general view and experience of work-integrated activities and co-production of knowledge we aimed to find a solid base for design of successful technology enhanced learning collaborations. An unsuccessful effort to implement TEL will clearly be reflected in terms of low knowledge development for both employees and participating companies (Parding and Abrahamsson 2010; Tavangarian 2004). Summarised results show that companies describe a rich variation of work-integrated learning activities, but a pretty low activity of external relations and co-production of knowledge with higher education and consequently a novel insight into the academic traditions. This means that collaborative activities between these parties for example focus groups and virtual meetings should be suggested further on. To socialize through use of media technology for meetings and knowledge interaction will perhaps widen the network relations on management levels (Döös and Wilhelmson, 2011; Wenger, 1999). Also, participation in the TEL courses experts can collaborate around production technology and broaden their knowledge. Innovative work needs special discussions continuously with management. They have responsibilities for creation of a creative and explorative culture within the organisations. Knowledge should be allowed to flow in- and outside with external actors and distributed between diverse contexts and not tied to formal institutional settings (Lea and Nicoll, 2013).

To widen our understanding of the relations and intersections between the analysed categories in this paper, a conceptual model is designed, see figure 1.

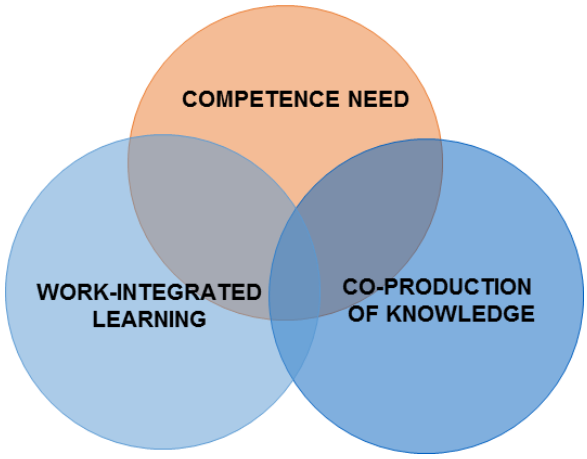

Figure 1. Conceptual model of competence need, work-integrated learning and co-production of knowledge.

Internal competence needs is an iterative process and render external communication and also work-integrated activities, which were analyzed in the earlier paper (Hattinger, 2014). The circles are intertwined because we want accentuate that WIL and co-production of knowledge are dependent on each other. As the categories in table 2 is described into WIL and co-production of knowledge, they represent analysed nodes that do not present tight boarders. Rather in the intersections of the categories lies interesting activities. As an example students that participate in a Co-op education program, belonging to CO-PRODUCTION/student collaboration can also be categorized into WIL/Educational design. Consequently, in the intersection of these both categories this example should be placed. We would therefor conclude to say that the categorizations have practical explanations of theoretical concepts.

6 Conclusion

We conclude that the managements view of knowledge and learning as well as the organizational culture will have an effect on how technology enhanced learning initiatives are designed and implemented in collaboration with universities. As we have described there are many pitfalls to consider because e-learning initiatives tend to fail if we do not plan ahead (Godvindasamany, 2001). Results show rich and fruitful variation of work-integrated learning activities, but the step towards external collaboration with academia for co-production of knowledge and eventually innovation is marginal. This imply the need for well-planned design of richer collaborative activities through use of media technology.

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