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Exploring Design Principles for Technology-Enhanced Workplace Learning

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Abstract

Technology-enhanced learning can be used to replicate existing teaching practices, supplement existing teaching or transform teaching and/or learning processes and outcomes. Enhancing workplace learning, which is integrated into higher professional education, with technology, calls for designing such transformations. Although research is carried out into different kinds of technological solutions to enhance workplace learning, we do not know which *principles* should guide such designs. Therefore, we carried out an explorative, qualitative study and found two such design principles for the design of technology-enhanced workplace learning in higher professional education. In this research, we focused on the students' perspective, since they are the main users of such technology when they are learning at the workplace, as part of their study in becoming lifelong learning, competent professionals.

Keywords: Higher Professional Education, Blended Learning, Workplace Learning, Technology-Enhanced Learning

1 Introduction

Institutes offering higher professional education programs face changing demands from society and industry. These changing demands on the starting professional call for adaptive curricula, which results in the need for a mature pedagogy and a suitable integration of workplace learning in higher professional education (Tynjälä, Slotte, Nieminen, Lonka, & Olkinuora, 2006; Zitter, Hoeve & De Bruijn, 2016).

The rapid change towards a worldwide digital economy has led to innovative educational technologies. E-learning, Massive Open Online Courses (MOOCs) and Computer-supported collaborative learning (CSCL) are examples of recent developments in Technology-Enhanced Learning (TEL). Blended learning (Garrison & Kanuka, 2004) started out as a mix between face-to-face and online learning, giving rise to virtually limitless design possibilities. Generally speaking, TEL can be used to replicate existing teaching practices, supplement existing teaching or transform teaching and/or learning processes and outcomes (Kirkwood & Price, 2014).

The integration of workplace learning in higher professional education calls for designing these transformations. In this paper, we explore which design principles (Sein et al, 2011) help guide the design for technology enhancing workplace learning. We focus on the students' perspective, since (s)he is the main user of such technology

when learning at a workplace, as part of their study in becoming a lifelong learning, competent professional.

1.1 Integrating workplace learning in higher professional education

Workplace learning has broadened from professional development of employees to taking an important role in formal professional education (Tynjälä, 2008). In professional Bachelor programs, students are taking internships in real-world workplaces for a significant part of their education. This has raised the attention to the role of reflection in learning, guiding and assessing learning processes in increasingly complex and unpredictable workplaces (Embo, 2015).

Learning in professional workplaces is often implicit in nature - it occurs during (collaborative) work activities such as problem solving and often results in tacit knowledge (Eraut, 2000). Consequently, it is hard to explicate what is learned by a specific learner at the workplace. Institutes offering professional and vocational education often tackle this problem by asking students to set their own learning goals and reflect on them, to assess the learning that took place while they were 'out of school' (Tynjälä, 2008).

Recently, efforts have been made to mature the design of learning environments for professional and vocational education, by suitably integrating workplace and school-based learning. To this aim, several models have been proposed such as Integrative Pedagogy (Tynjälä et al, 2006; Tynjälä, Stenström & Saarnivaara, 2012) which focuses on different types of knowledge and skills as learning outcomes, and Hybrid Learning Environments (Zitter et al, 2016), focusing on invoking different learning processes that result in integrated and contextualized knowledge.

1.2 Technology-enhanced workplace learning

Meanwhile, tools supporting professional development in certain professions have been analyzed and evaluated. Firstly, the focus was on explicit workplace learning (e.g., trainings and workshops). For instance, Dolog et al (2007) studied how e-learning systems for the workplace can be adapted for personalization.

Several recent studies consider the support of learning for professional development, i.e., after formal education has ended. In one study, the use of mobile devices by nurses for informal learning and continuing professional development is analyzed (Fahlman, 2013). In another study, the possibilities and challenges of using social media to stimulate reflection and sharing tacit knowledge with others in the workplace was studied (Tynjälä, 2014). Gamrat (2014) introduced a framework for professional development for teachers, including an online workplace learning tool using digital badges. Recently, Hämäläinen and Cattaneo (2015) studied TEL environments for vocational education from a teacher's instructional perspective.

Concluding, different studies were carried out to analyze to what extent existing tools and technologies can support workplace learning. Still unexplored is *which design principles* guide technology that effectively enhances workplace learning. Especially such design principles from a student's perspective - as main users of such technology - have not been studied systematically yet.

1.3 Research Question

This paper builds on the above work by exploring design principles that help guide the design of technology to enhance workplace learning by students in higher professional education. These design principles will guide the subsequent process of requirements engineering, necessary to successfully develop new technological solutions to enhance workplace learning. The research question is formulated as follows:

Which design principles guide the design of technology-enhanced workplace learning from a students' perspective?

2 Method

To achieve our research goal, we adopted an inductive approach by conducting an explorative, qualitative study. The context of this study was a Bachelor program educating Information and Communication Technology professionals (at the HU University of Applied Sciences Utrecht). We focused on the third-year internships; a compulsory part of 30 EC¹ of this Bachelor program.

To answer the research question, we carried out interviews (Mears, 2012). We interviewed six third-year students doing their internships at that time. The interviews all took between 45 and 75 minutes and were audio-recorded.

The interviews we conducted were semi-structured, because of the research's explorative nature. We took a user-centered design approach, in which an explicit understanding of users, their processes, tasks and environments is the basis for determining the kind of support technology can offer (ISO, 2015). The precompiled list of interview questions was composed of four categories:

1. Students' awareness of their learning process in the workplace;
2. Transitions to facilitate their learning process - based on the framework of Zitter et al. (2016); we searched for activities related to what the Integrative Pedagogy model (Tynjälä, 2006; Tynjälä et al, 2012) calls *mediating activities*;
3. Technology currently used to organize working and learning;
4. Wishes for future technology to enhance workplace learning.

Next, we analyzed the audio-recordings with Atlas.ti (Atlas.ti, 2016). First we used qualitative analysis (Miles, Huberman & Saldana, 2014) in the form of open coding on all relevant audio segments. Next, we generated and analyzed a code co-occurrence table to compile code groups to simplify analysis. For this paper, we summarized the results of this analysis. A more extensive analysis will be performed in the near future.

3 Results

The results of our explorative, qualitative study are presented in this chapter.

1) European Credit Transfer and Accumulation System (ECTS), 1 EC is equivalent to 28 hours of study in the Netherlands.

3.1 Workplace learning process

Firstly, we analyzed the working and learning processes that take place during internships. Students tend to be capable of explicating what work they do, however, they all indicate they are hardly aware of what they learn. One student stated: *“I don’t realize I’m learning, I’m just busy doing my work.”* They all set learning goals at the start of their internship, but hardly follow these up. University demands do not trigger students to do so until the very end of the internship. Students don’t see the need for more attention on learning and learning goals, primarily because *“the grade does not depend on it”*. To write their final internship report, they have to reflect on what they did; only then they (partly) realize what they learned in the preceding months. However, they do fill out log sheets with day-by-day activity listings (because they are required to do so by their university). They don’t like filling out the sheets, since they perceive this as a tedious task.

They do realize what their main learning resources are: they mention publications, online lectures, programming community sites like Stackoverflow, and feedback from their daily supervisor in the workplace. They receive feedback on task performance, teamwork and communication at least once a week, still this does not seem to increase their learning awareness. They have contact with their supervising teacher a few times during their five-month internship, and the feedback they get from them is mainly about the deliverables for the university.

3.2 Technology support

The above analysis implies major gains can be achieved by using technology to increase the awareness of workplace learning of students. The greater part of the day, they are ‘stuck’ in being busy with their work and learning is implicit to a high degree. Technology can be designed to trigger them to reflect on their experiences by invoking reflective practice (e.g., Thompson & Pascal, 2012), to help students make implicit knowledge more explicit. Besides, automating the tedious activity logging could serve as the means to this end: e.g., automated, formative reports on their activities based on text analysis, could create awareness of what is being learned and facilitate reflection and interventions during the internship.

Students often make the transition between theory and practice. Technology can offer support by automatically collecting information about which resources they used, to facilitate future reference by the student and increase awareness of this type of learning process.

In general, these findings are consistent with (Tynjälä et al, 2014), stating that technology can support workplace learning by serving as mediating tools – tools that help a student either 1) make connections between theory and practice or 2) to reflect on their experiences.

3.3 Design principles

From the above analysis, we infer that the nature of workplace learning asks for technology of the type *Low effort - High frequency – High impact*. To really capture implicit learning, learners should use – and keep using - the technology regularly throughout their workplace activities.

Combined with the wishes expressed by students during the interviews, we conclude this study by formulating two design principles to help guide the design of technology to enhance workplace learning.

Ease of use

Students indicate the need for a system with an easy and accessible user interface with a natural user experience (ISO, 2015) extended with options for customization and personalization, e.g. the system could pre-enter activities in the log sheet based on the students' project planning.

Surprise effect

Students should be positively surprised by the technology. Firstly, it creates awareness. Surprising a student by stating explicitly which implicit knowledge they have gained, can stimulate learning in a positive way. Secondly, it has a positive effect on their willingness to keep using the technology. The surprise effect can be two-fold:

- 1) Students get feedback when they don't expect it (i.e., early in time).
- 2) Students get feedback they don't expect (i.e., the technology supplies previously unknown information).

4 Conclusion and Next Steps

We propose two major design principles for technology-enhanced workplace learning from a students' perspective: *ease of use* and *surprise effect*. We believe these principles are essential for new technology designed to support workplace learning.

Over the next months, a group of Bachelor ICT-students will design and implement a tool prototype guided by these design principles. In the fall of 2016, this prototype will be tested and evaluated with a group of third year students doing their internship.

We are aware of the fact the students we interviewed all work in the domain of ICT, therefore we expect that our findings are not easily generalizable to other professional domains. Therefore, we plan to interview students from other domains in the future. This study focuses on the design principles from the students' perspective. Other groups of stakeholders are the teachers and the professionals from industry acting as the daily supervisor during the internship. We plan to study the needs and wishes from their perspectives in future research.

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