Work-integrated Learning in a Doctoral Course in Informatics

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Abstract. Being the first university in the world to provide doctoral program in Work-integrated Learning (WIL), we face the challenge of how to integrate doctoral courses into the WIL philosophy, which is the profile of the University West, Sweden. To exemplify what we mean by such a notion of integration, we introduce and demonstrate our proposed ontological approach to integrate a PhD course into the fundamental concepts underpinning WIL. The WIL within the context of informatics research (which is a subfield of the IS discipline) plays five different roles of (1) the main course content, (2) the target occupation of the students and occupational field of the teachers, (3) the analytical perspective of the research activities in the course, (4) the educational method where teachers and students conduct collaborative research activities as a cognitive apprenticeship learning model, and (5) a co-authored research paper as outcome. The outcomes of such a conducted approach and lessons learned from the course will be thoroughly described. In the course, a meta-analysis of WIL informatics research will be performed to examine four dimensions which are: theories relevant for WIL; methods used in WIL research; occupational fields in WIL-informatics studies; and roles of technology in WIL research. The course is arranged in the these phases: *Local investigation*; locally rooted research within the informatics field is examined by the course participants in dialogue with the authors of a number of published articles in order to see the extent and the how aspects of these identified WIL-oriented research work; *Local synthesis*; both teachers and the PhD students (i.e., course participants) explore the results and synthesize a local WIL-model; *Global overview*; a number of related international literature is selected and studied; *Global synthesis;* The local WIL-model is compared to the global investigation. *Co-authoring*; a research paper is co-authored by the course participants and presented at a conference. By doing so, we enhance our understandings and thus contribute to one additional practical application of WIL's pedagogical philosophy, which influences the course content, the course format, the activities, the teaching-learning model, and the outcome of the course.

1. Introduction

Claiming to be the first university in the world to offer a PhD education in Work-integrated Learning (henceforth WIL), we are faced with an array of small and big challenges of how to integrate WIL philosophy into the doctoral courses. Not only the content of our offered PhD courses, but also considering the whole format of the course design. According to Babaheidari & Flensburg [1], "Depending on which extent the concept of WIL has been perceived by universities worldwide, it has been thus viewed and implemented from a diverse spectrum of perspectives." WIL has been also viewed as an approach to learning that emphasizes the importance of combining academic knowledge with work place skills in the curricula, with the ambition to develop relevant competences [2]. In our case, we face the challenge of educating doctoral students to become senior researchers within *Informatics* Work Integrated Learning (IWIL). Thus, our exploration of the WIL concept is delimited to a subfield of the research domain namely Informatics. Since we are the first research school within IWIL, there is a need for an improved definition of the concept IWIL and the methods for learning within the IWIL research school. The objective of this paper is to explore the concept of IWIL. To achieve such an objective, we propose an ontological approach to WIL in order to develop WIL-oriented PhD courses.

In this paper, we report on design of a PhD course in Informatics where WIL influences all dimensions of the course: content, format, activities, teaching-learning model, and outcome. The course 'Informatics with Specialization in Work Integrated Learning: Development and Research' is currently given at the department of Informatics at University West, Sweden. It is conducted as an apprenticeship-inspired collaboration between the PhD students and the teachers who are following the pedagogy of cognitive apprenticeship [3].

Research questions:
1. How could a doctoral course in Informatics work-integrated learning (iWiL) be designed and realized?
2. How is the concept of iWiL realized in the current research?

2. Theory

2.1 Informatics

Information technology (IT) can be views as the core of informatics. It justifies the existence of the field and distinguishes it from other social science disciplines. To understand what IT can be and how IT can relate to people and society then becomes crucial within IS research [4]. Since technology and organizations are constantly changing a major focus on education and learning is required. The challenge for the

informatics discipline, is therefore not about developing organizations to suit the contemporary society, but rather to design organizations for an uncertain and ever-changing future. Organizations and individuals in organizations need to be self-learning so that they can handle the change. Thus, change is a crucial aspect of informatics [5].

2.2. Work-integrated Learning

Work-integrated learning or WIL refers to the practice of integrating traditional academic study, or formal learning, with student exposure to the world-of-work in their chosen profession. It contains two connected concepts, work and learning. Patrick et al. [6] define WIL as follows: *'an umbrella term for a range of approaches and strategies that integrate theory with the practice of work within a purposefully designed curriculum'.* The purpose of using WIL in higher education is to better equip students with the skills needed in a future workplace, and accordingly to improve their employability [7]. In this sense WIL becomes an important investment in order to keep up with globalization and strong competition between universities. WIL may also provide a number of benefits for both universities and students in higher education [8].

There is not just one form of WIL that covers and explains the integration of academic study and work, but all approaches have in common to encourage students to experience realistic work practice. There are also several definitions of "real-life workplace experience" such as industry-based learning, experiential learning, workplace learning, work-based learning, professional learning, and work placements and they all refer to the concept of 'learning in the workplace' [7]. In the research concerning education, there has been an increasing focus on authenticity in the learning situation and that the learning situation should be focused on realistic problems [9]. WIL can include a variety of approaches where the intention of the curriculum design is to integrate theory with workplace practices such as placements, internships, and simulations. The intention is to find a place of professional work that are relevant for the student's studies [10]. These authors also emphasize that work-integrated learning should not be confused with work- experience since that has more to do with practice and less to do with academic theory.

3. Previous Research

Information technology (IT) can be views as the core of informatics. It justifies the existence of the field and distinguishes it from other social science disciplines. To understand what IT can be and how IT can relate to people and society then becomes crucial within IS research [4]. Since technology and organizations are constantly changing a major focus on education and learning is required [5]. The challenge for the informatics discipline, is therefore not about developing organizations to suit the contemporary society, but rather to design organizations for an uncertain and ever-changing future. Organizations and individuals in organizations need to be self-learning so that they can handle the change. Thus, change is a crucial aspect of informatics, wrote [5].

3.1 Work-integrated Learning at University West

Since the 1980's the GNP of the local region where University West is active, has decreased. As a result, political efforts have been made with the purpose of increasing the regional growth. University West is situated in a region with a lot of industries with a high demand on competent work force. Founded on these elements, University West developed curriculums that combined traditional theoretical academic components with work-place learning, called Co-op. Since 2002 University West has a national mission to develop the term Work Integrated Learning. The definition used in University West differs from the WIL-definition used in international research through the fact that less emphasis is put on higher education as a context for WIL. Instead the term is more associated to organizational learning or workplace learning. The definition of WIL used by University West: *"Work integrated learning, WIL, can as a concept in a broad sense include all learning aspects that somehow are connected with or linked to activities that qualify as work. Work in this context, must not necessarily be linked to paid work, but also activities targeted for voluntary of non-profit work."* The connection to higher education and its curriculums is not emphasized in the definition that University West use. Instead, the definition looks upon WIL as something that can be applied upon a broader research field connected to the concept of learning in an organizational context, and not necessarily as learning connected to higher education. Therefore research at University West does not only focus on the outcome of students' workplace learning but also on how organizations and their members learn and develop new competence.

4. Course Design

The overall approach was collaborative where students and senior researchers (in the role of mentors and project leaders) worked together with a mutual goal: to explore the IWIL field. It was organized in weekly workshops, which was run as project team meetings where the students reported on their individual task from last week. The individual works were then discussed and confronted with the others' work and the teachers' responses and reactions, with the aim to have in a mutual common "result" and a task for next week in the end of the day. This way, the seniors' thinking, approaches and way of organizing research became explicitly visible in action, as a WIL format of learning research activities.

The course was divided in two phases: a local followed by a (minor) global investigation. The idea was to dig where we stand, i.e., with a grounded-theory inspired approach by first examining our own research which we classify as Informatics Work Integrated Learning (IWIL), then turn to the outside world. The global investigation had to be very restricted to fit into a course format. Finally, the result of the two investigations were analyzed and presented in a coming paper and as a poster in a conference.

5. Method

In the following section we describe the work of analyzing, categorizing and synthesizing WIL research articles from a local and global perspective.

5.1 Local Investigation

Inspired by the inductive research methodology Grounded Theory (GT) we took a data-driven, empirically-based approach to derive IWIL relevant categories/concepts to base our analysis upon. Three articles each (a total of 17) from local senior researchers were analyzed with special respect to concepts relevant for WIL and IS, such as 'work', 'learning', 'change', 'organization' and 'IT/IS'. During a group discussion between the PhD students and a senior researcher students, the following 15 components where identified, as major guiding categories for the upcoming analyses of the articles:

Table 1: 15 components/aspects of IWIL-oriented articles/works

Aim	Unit if analysis	Role of Technology
Role of Learning	Domain/organization	Research question
Publication status	Context	Method
Theory	Role of researcher	Type of results
Contributions	Research approach	Publication status

All 17 local research articles were then again analyzed individually by each Ph.D. student with a focus on the 15 categories. The result of the analysis was then compiled and discussed in the group.

5.2 Global Investigation
In this phase the Ph. D. students chose and categorized IWIL articles in an international research context. Each student was to find and categorize at least 3 IWIL articles by identifying the 15 components. The analysis was presented to the group, which commented and gave feedback on the performed analysis.

5.3 Local and global synthesis – grounded theory approach to produce the model
As a result from the investigations, a categorization model containing *three types of IWIL research* emerged as a potential way of understanding the field. These types where 1) pedagogical models for learning at work, 2) change of work practices due to technology, and 3) models for integrating work into education. The model was then used as a conceptual analytical lens. Based on the model, the Ph.D. students and senior researchers individually classified all articles (17 local, 17 global) and the results were compared in order to evaluate the usefulness of the model. Most articles were classified into the same category by all. The few inconsistencies were discussed and easily resolved. The final step was to compare the all articles with respect to origin (local/global).

6. Results and Analysis

The collaborative process of analyzing local and global articles related to Informatics Work Integrated Learning resulted in a conceptual model with three IWIL-categories

reflecting three types IWIL research. The categorization is based the how the concepts work, learning, change, and IS/IT (Information System/Information Technology) relate to each other:
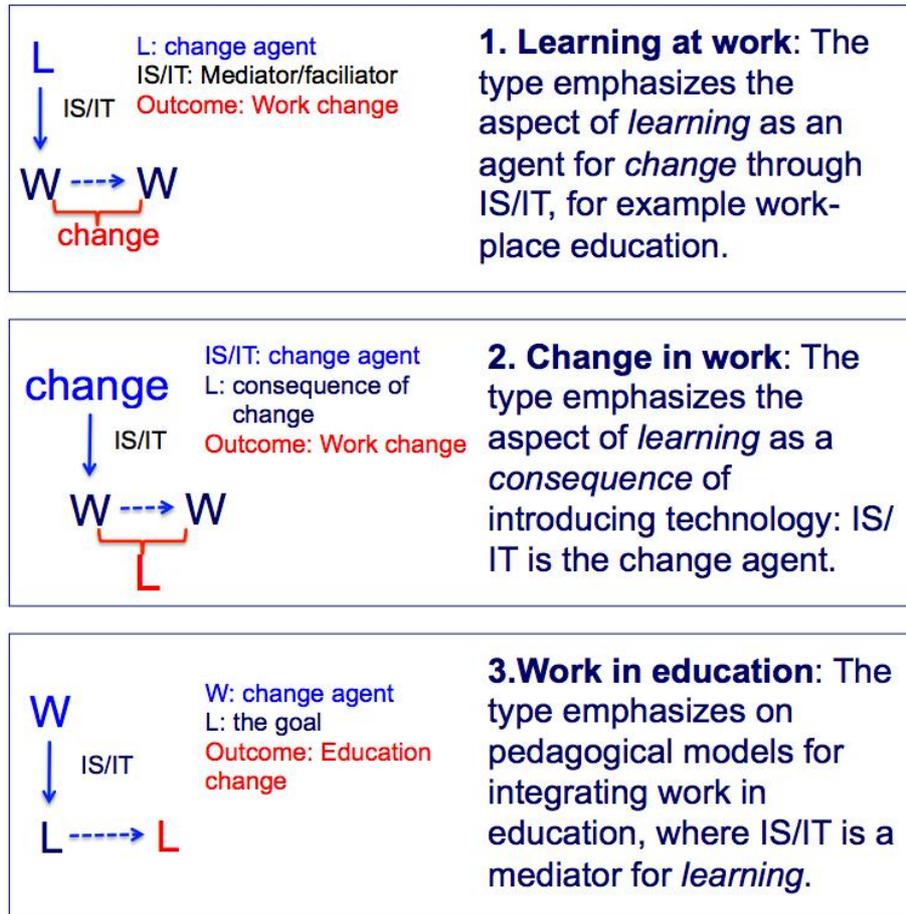

Figure 1. Conceptual model with 3 consisting iWiL-categories

6.1   IWIL: local versus global

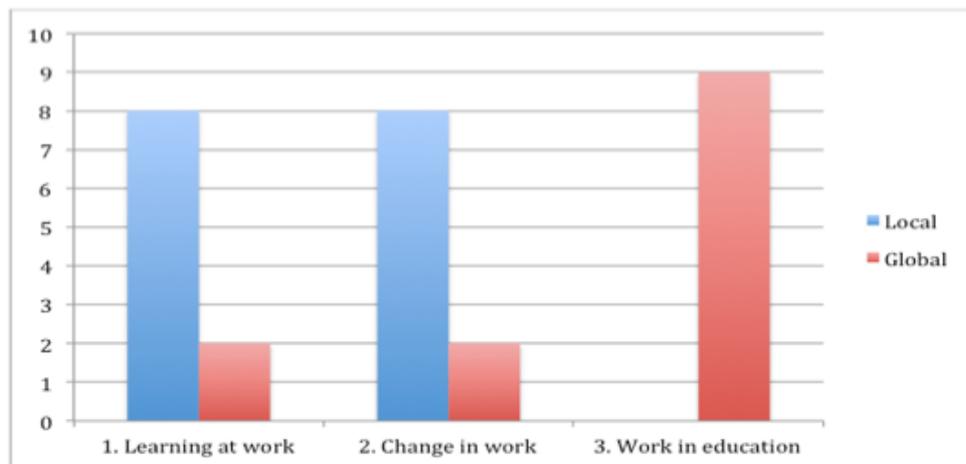The comparison of analyzed articles with respect to origin, resulted in the following as shown in the diagram below:

Figure 2. Comparing results between Local and Global iWiL-papers

The selected local articles were interpreted as belonging to either research type **(1)** or **(2)**, none of them were interpreted as belonging to **(3)**. However, this is partly because we restricted local articles to informatics researchers; type **(3)** research is more common among technology-interested WIL-pedagogues. The selected global articles were interpreted as belonging to all 3 types, with component **(3)** as the most frequent one. With respect to study duration, most studies were fairly long: Globally, there were 3 studies of one year or longer, whereas locally there were 10 studies of such length. Most studies were conducted in the organization or at a work place, showing that the context seems to be important for IWIL research. In the locally conducted research, there were more action-oriented research (total of 7) than in the analyzed global articles (total of 2), which may reflect the overall culture (i.e., the Scandinavian school, see e.g. xxx) more than of the type of research itself.

6.2 Local versus Global - Preliminary results of the analysis based on model

The selected local articles were interpreted as belonging to either category 1, 'Pedagogical models for Learning at work or (8/17) or category 2, 'Design IS/IT for (changed) work practices' (9/17). None of them were interpreted as category 3 'Design pedagogical models for integrating work in education'. Hence the studies from local researcher focused on workplace learning in various ways such as organizational development, institutional learning, professional development, competence management and transition of work, due to development, innovation and changed circumstances in society, see for examples [11-15]. This is aligned with the definition of WIL used in the University West policy-documents. However, similar research is also to be found worldwide, e.g. focus on how new technology leads to change in the workplace, see e.g. [16, 17]. However, the local approach of embracing IWIL differs from the global. Outside University West, IWIL seem to focus pedagogical design in formal higher education i.e., how the work can be integrated within the educational context, see e.g. (e.g.[18, 19] as well as the shift from education to work [20]. The different focus leads, not unexpectedly, to different ways to design, analyze and

present the research. The research locally is often based on longitudinal studies, see e.g. [11, 12, 14, 15, 21] and action oriented research, see e.g. [13, 22, 23], which is not the case outside University West, where more traditional approaches are applied e.g. [18, 19]. The local and the global understanding of the label IWIL is overlapping, however involve quite separate focus and application.

6.3 Evaluation of the IWIL model and suggestion for further work

The conceptual-models presented in the previous section can be seen as building blocks for further research in search for the 'iWIL' in IS-related research. The researchers' high level of consistency in terms of categorization led to the perception that the model was applicable. Applying the model was, according to us, a feasible way to classify 'iWIL'-research.

A suggestion for further development could be to integrate the three models and describe them through an ontology [10, 24-27]. The ontology could be served as a descriptive enterprise seeking for a taxonomy and description, rather than seeking for explanations. Doing so, a terminology together with significant properties could be determined to use for describing and refining the dimension of 'iWIL' in IS-research. Finally, the ontology could be used to override some difficulties with communicating the 'iWIL' internationally.

7. Discussion

The study reveals that the research focus of IWIL at University West, where WIL is an integrated part of the research school, differs from the focus of international IWIL research. The difference could partly be traced to the geographical location of University West in a city with a history of having big industries and consequently nearness to external partners and connections to the manufacturing industry. The university has started as a more traditional WIL university with focus on WIL in the undergraduate education, but has recently started to label the research as WIL as well, even though that means extending the concept of WIL to research on pedagogical models for learning at work; change of work practices due to technology; and not necessarily learning connected to the academy.

The different focuses locally and internationally, however, raise questions regarding how the concept of IWIL may be used. Should the differences be seen as complementary, enriching each other and perhaps reducing the differences that might lead to a merge focus in the future? Or should the differences be considered as opposites, which undermines the concept IWIL? We think the IS research could be helped by combining the three different focuses since researchers with interest in IWIL could be inspired by all focuses. Research on changed work practice due to technology could e.g. take help of pedagogical theories from the other two research focuses to understand the better understand the change going on. Similarly, research with a focus on pedagogical models or learning at work, or models for integrating work in education, might be helped by a better understanding of how technology can work as change agent.

8. Conclusion

RQ1: How could a doctoral course in Informatics work-integrated learning (iWiL) be designed and realized?

By applying an apprenticeship learning model as a teaching and learning approach at a Ph.D. course, students and senior researchers together, worked out a model for categorization of the research area Informatics Work Integrated Learning (IWIL). The senior researchers worked as project leaders and mentors during the course which meant they set up frames for the course and lead the work, but let the qualitative work of analyses and categorization be done by the students themselves individually and collaboratively in a mixed group of students and seniors. The goal of defining the IWIL research field was not defined from the beginning but was instead an authentic goal that all in course (both students and senior researchers) were eager to explore to increase the knowledge of the core field of the research school they all belonged to. In the group meetings during the course the senior researchers were explicitly acting as authentic researchers which helped the Ph.D. students to see how research could be conducted. That could include helping to bring out the good parts of the students individual analyses, compiling the individual analyses, discussing and thinking out loud in the work of analyzing the compiled material.

RQ2: How is the concept of iWiL realized in the current research?

Since the concept IWIL is relatively undefined, a grounded theory inspired research approach was conducted where research started locally and was then broaden to an international context. The apprenticeship learning model and a grounded approach to the literature review and analyze of local and global WIL articles, together resulted in a model of IWIL including three different research focuses: 1) pedagogical models for learning at work, 2) change of work practices due to technology, and 3) models for integrating work into education. The local WIL research had a focus on 1 and 2 while the international IWIL research had mainly a focus on 3.

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