Experience and Shared Practice – Design Engineers’ Learning at Work
Kaija Collin, University of Jyväskylä

Abstract

The study investigates design engineers’ and product developers’ learning through their work. The aim was to approach designers’ work practice and their learning in the course of it as perceived by the designers themselves. The aim was also to examine their learning through the various individual and social processes which take place in the workplace. The study thus addressed three major questions: 1) What conceptions do engineers have of learning at work? 2) What role do previous work experiences have in on-the-job learning in the domain of design work? and 3) How do engineers learn through shared practices of design and development work? The report is based on five articles published in 2002-2005.

The ethnographic approach with its use of combined and qualitative data gathering and analytical methods was selected to answer the above questions. Observations in two Finnish high-tech companies and interviews with 18 designers were conducted within an ethnographic framework. The observations and interviews were analysed with help of combined methods of analysis, such as phenomenographic, narrative and ethnographic analysis.

The findings suggest that in redefining designers’ work and learning, four central themes are important: 1) design practice is learning in itself; 2) there is a close relationship between formal and practical knowledge in designers’ learning at work; 3) previous work experience plays an essential role in learning; and 4) design practices and learning should be seen as shared, situated and contextualized. It was concluded, on the more general level, that the learning which takes place at work cannot be approached with the help of vocabulary borrowed from formal education. Neither can this phenomenon be described solely as informal. Moreover, individual and social practice and learning in the workplace should be seen as interdependent and intertwined.

Various further ideas for researching designers’ learning in their practice and how the formal education of designers could be developed in connection with these ideas are offered. In addition, more general suggestions concerning the guidance of workplace learning are given, and the challenges of guiding and assessing workplace learning in the vocational education context are examined. There is a clear need for more effective integration between education and working life.

Introduction and the purpose of the study

This study investigates design engineers’ and product designers’ learning at work. The work bases on the PhD study consisting of summary and five articles published between 2002 and 2005. The reasons for the growing interest in workplace learning over the last decade are diverse. For instance, the concept of knowledge society and learning society (see e.g. Heiskanen 2004), which is increasingly referred to, challenges workers and organisations to structure work in new ways. The phenomenon of workplace learning
interests many quarters, e.g. enterprises and organisations, vocational education personnel, human resource development practitioners and workers themselves, but from different and various motives. From the point of view of enterprises and employers, for instance, employees’ learning through work contributes to the development of the vocational and professional knowledge needed for work. An equally important reason usually associated with companies and organisations is that learning is directly relevant to their specific needs which, it is hoped, will lead to better productivity and increased competitiveness (Billett 2001). For the individual worker, constant learning may be the route to personal fulfilment and joy, progress in one’s career or a way to strengthen the sense of self and identity (Lavikka 2004).

Characteristics of workplace learning. Although studies in the area of workplace learning have increased remarkably in recent years it is complex and challenging focus of investigations (Eraut, Alderton, Cole & Senker 1998; Billett 2001; Engeström 2001; Gerber, Lankshear, Larsson & Svensson 1995; Marsick & Watkins 1990; Wenger 1998). Studies in the area still seem to lack systematic, sensibly conceptualised and comprehensive theorisation (Candy & Matthews 1998). However, despite the eclectic and pluralistic nature of the research that has been done in the field and the deficiency of appropriate conceptual and methodological tools, it is possible to discern a certain measure of agreement about what characterises this phenomenon. First, workplace learning is described as informal, incidental and practice-bound, this is, learning and work practices are difficult to separate from each other in rapidly changing situations of working life (see e.g. Lave 1993; Watkins & Marsick 1992). Second, individual former work experiences seem to have foundational importance for work and learning (Beckett 2001; Boud & Miller 1996; Gerber 2001). Third, working tasks and contexts determinate what and how it is possible to learn at work (Brown, Collins & Duguid 1989; Karakowsky & McBey 1999; Lave & Wenger 1991). Finally, learning is shared and it usually seems to occur together with colleagues and various networks connected to work practices (Eteläpelto & Collin 2004; Gherardi 2001; Orr 1996; Rainbird, Fuller & Munro 2004).

Product design and development has previously been described as individual and linear problem-solving process. Instead, more recent studies emphasise that design is a collaborative and “messy” practice rather than intentional planning or following a general problem solving procedure (Gedenryd 1998; Henderson 1999; Schuler & Namioka 1993). It is also a common endeavour of design group and takes place within multi-professional teams and within larger organisational contexts (Sharrock & Button 1997; Eteläpelto 1998). Consequently, design work should be seen as innovative and creative practice which requires continuous learning and development.

The aim of the entire research process was to capture design engineers’ own conceptions and experiences of their learning in authentic work contexts as well as describe how their learning is attached to the work itself and to various social processes of the work practices. The study addressed three major questions: 1) What kinds of conceptions do design engineers have of learning at work? 2) What role does previous work experience have in on-the-job learning in the domain of design work? 3) How do engineers learn through shared practices of design and development work?
Methods

Since workplace learning is multi-faceted and ill-defined as a phenomenon, a holistic methodological approach comprising both interviews and observations is adopted for this study. The study focussed, first, on design engineers’ conceptions of their learning and their views on the role of the previous work experiences for their learning. Second, what everyday work practices and collaborative action looked like from the learning’s point of view, was examined. Ethnography was thus chosen as a larger methodological approach. Within ethnographic frame different data collection and analytical tools were used complementarily. Designers’ conceptions and experiences were mapped with the help of interviews (n = 18) and analytical methods applicable to research questions, such as phenomenographic and narrative analysis. Shared practices were examined through observations (5 to 6 weeks in each company) and ethnographic analyses. A more detailed description of the specific research tasks and the materials and analytical methods used is in table 1 below.
<table>
<thead>
<tr>
<th>Research tasks and problems</th>
<th>Materials</th>
<th>Analysis</th>
<th>Article</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What kinds of conceptions do design engineers have of learning at work?</td>
<td>Thematic interviews with eighteen product designers and development engineers from two companies.</td>
<td>Phenomenographic analysis</td>
<td>I Development engineers’ conceptions of learning at work (2002)</td>
</tr>
<tr>
<td>2. What role does experiences have in on-the-job learning in design work?</td>
<td>Thematic interviews with eighteen product designers and development engineers from two companies.</td>
<td>Narrative analysis.</td>
<td>II The role of experiences for development engineers’ work and learning (2004)</td>
</tr>
<tr>
<td>3. What is learned through experience?</td>
<td>Observations, field notes and transcribed team meetings and discussions between employees.</td>
<td>Ethnographic analysis.</td>
<td>III Development engineers’ work and learning as shared practice (2005)</td>
</tr>
<tr>
<td>3. Why is learning through experience an important way of learning in design work?</td>
<td>Observations, field notes and transcribed team meetings and discussions between employees.</td>
<td>Ethnographic and adopted membership categorization analysis.</td>
<td></td>
</tr>
<tr>
<td>1. What does the everyday shared practice look like?</td>
<td>Observations, field notes and transcribed team meetings and discussions between employees.</td>
<td>Ethnographic and adopted membership categorization analysis.</td>
<td>IV Interaction Among Employees – How does learning take place in the social communities of the workplace and how might such learning be supervised? (2005)</td>
</tr>
<tr>
<td>2. What kinds of contradictory aims and demands practice can include?</td>
<td>Thematic interviews with eighteen product designers and development engineers from two companies.</td>
<td>Adopted phenomenographic analysis.</td>
<td>V Integrating theory and practice? Employees’ and students’ experiences of learning at work (2003)</td>
</tr>
<tr>
<td>3. What and how is it possible to learn through shared practices of design work?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The participants and the contexts of the study. The design and product engineers were chosen as participants for the study from two high-tech companies in central Finland. The other company is an international supplier of industrial workstations and flexible production systems while the other services to the electronics manufacturing. Educational background of the participants varied from vocational education to university degrees and their work experience varied from a few months to more than 20 years.

Analyses. The analysis of observations and interviews was started by mapping the designers’ own conceptions of how they see their learning at work. This was accomplished with the help of phenomenographic analysis of the interviews. As a result of this first phase analysis altogether six categories of description were produced. On the basis of designers’ own perceptions the most important categories were then chosen to be further analysed. Next the role of designers’ former work experience was examined by narrative analysis based on interviews as well. Social and shared nature of work practices was analysed ethnographically on the basis of observational material. In addition, workers’ experiences of the relation between learning in formal education and through work practices were compared.

Results and conclusions

This chapter summarises the main findings of the five articles produced to study design engineers’ learning at work. Table 2, follows after the depiction of results, presents a summary of the main findings of the articles.

Design engineers conceptions of learning at work. The first phase phenomenographic analysis of this study revealed the multi-faceted nature of workplace learning. The analysis produced six different kinds of conceptions of learning at work (see Collin 2002). The first and the second categories emphasised the meaning of doing the actual job and the importance of learning through co-operation and interaction in everyday work practices. The role of prior experience for learning at work was also praised even though designers stressed that their work also requires learning through taking over something entirely new, this is, acquiring new information, considering various options, experimenting, developing fresh ideas, that is, acting creatively, and producing something new. In addition, designers perceived that the role of former education and various other contexts outside the work should not overlooked as a source of learning.

The role of former work experiences for designers’ work and learning. On the basis of the conceptions of learning at work obtained from the phenomenographic analysis the role of experience for designers’ work and learning seemed to be a theme that merited closer scrutiny (see Collin 2004). Experience seemed to have a major role in designers’ everyday interaction with each other and co-operation in general. Co-operation and interaction are a means for learning but, at the same time, also the focus of learning, and can take place only through working with other people. Designers emphasised that learning within everyday social interaction was characterised by the important role of learning through practical experience. Another dimension that emerges from narrative analysis was the vital role of acquiring a holistic picture of work processes and projects. This kind of work process knowledge (see Boreham, Samurcay & Fisher, 2002) is best obtained through everyday experience of the job. Designers also told that the experiences or mistakes of other people, for instance colleagues, may be as instructive experience as their own. Above all, the designers stressed that work experience accumulated through one’s career is the vital source of how they create their own ways of thinking and see what is important in design.
Engineers learn through shared problem solving and shared practices. The social interaction and shared practices of design work were investigated more profoundly with the help of ethnographic analysis (see Collin 2005; Collin & Valleala 2005). Four thematic categories characterise learning through shared practices. First, maintenance of a sense of community and good atmosphere were important components of work processes and learning in them. However, the efforts made to sustain this sense of smooth interaction were quite considerable. A positive atmosphere was achieved, for instance, by joking with colleagues and labelling (team) participants not physically present (see Sacks 1992). This kind of joking and social categorisation is one example of an activity where each worker’s identity and status within the work community is constructed and defined (Billett & Somerville 2004). Categorisation enables workers to find out how they are rated in their work environment. Second, ethnographic analysis revealed that work practices are temporary and situational and in a state of constant flux. Working goals and plans are redefined during processes and projects. Problems and their solutions are also negotiated and constructed anew on each occasion in teams and groups. Third, shared practices were not constituted without problems, but teams’ inner practices included conflicts and disagreement. Everyday practice may thus include disagreement and dissension, which may cause harm and challenges to social learning, but which also have a function in creating solidarity between team members against external forces. Fourth, the results imply that in order to accomplish everyday practice, designers’ work in reality often involves, in addition to the closer social community and team described above, collaboration with various groupings and networks outside the workplace. Accordingly, as the engineers described it, their work meant continual negotiations with the customer about their requirements and how these could be satisfied. Designers also stressed that the successful completion of a task depends very much on having as comprehensive a grasp of the relevant work processes as possible.

Comparing designers’ learning in formal and informal contexts. Also the designers’ conceptions of learning in formal education and at work and the relations between those learning contexts were examined (see Collin & Tynjälä 2003). The analysis yielded three ways of seeing the relation between the designers’ perceptions of theory and their perceptions of practice in work and learning. Firstly, the relationship between theoretical knowledge and the practical competence acquired on the job was perceived as a continuum. On this view one is aware of the distinction between knowledge gained at school and knowledge accumulated at work, but at the same time one recognises both as necessary preconditions of the successful performance of one’s job. Secondly, theoretical knowledge acquired in formal education is replaced by new practical knowledge required at work. Thirdly, theory and practice are complementary and often integrated components of competence, both of which are needed in working life. The designers perceived the contexts of learning in education and at work as different as well. For instance, the two contexts differ in their aims. Work and learning at work draw their deepest motivation from “an authentic, concrete or real aim that the work activity is intended to achieve”. In working life such an aim is easy to picture, while merely studying for an exam is not seen as enough of a challenge to taking learning seriously.

Individual experiences and shared practices of learning at work connected? On the basis of the results described above design work and learning through it was redefined: 1) Learning and work practices cannot be separated from each other. Learning subsumes in design practice itself. 2) The separation of theory and practice is not necessary in everyday practice. 3) Prior work experience has a major role in learning through design work. 4) Design practices are situated, shared, networked and contextualized. At a more general level it can be concluded that learning in the workplace cannot be described or explained only with the help of concepts and ideas borrowed from formal education. Instead, it should be addressed in terms of its own vocabulary and processes. Neither can the nature of workplace learning be caught by describing it informal only. Instead, many of the
processes have been able to revealed in the studies of this area. The most important conclusion arising from the findings of this research is that individual aspects, for instance, the essential role of the subject’s accumulated previous work experience and the social life of working practices, should be treaded as intertwined in the phenomenon of workplace learning (see also Billett 2005).

**TABLE 2 Summary of the main findings**

<table>
<thead>
<tr>
<th>Conceptions of learning at work (article I)</th>
<th>The role of experiences for learning (article II)</th>
<th>Work and learning as shared practice (article III and IV)</th>
<th>Integration of theory and practice (article V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Learning through doing the job</td>
<td>1) The challenge of social interaction at work</td>
<td>1) Maintenance of a sense of community and a good atmosphere</td>
<td>A) Relationship between theory and practical action:</td>
</tr>
<tr>
<td>2) Learning through co-operation and interaction with colleagues</td>
<td>2) Acquiring a holistic picture of work processes and projects</td>
<td>2) Practice is situated, interim and open-ended</td>
<td>- as a continuum</td>
</tr>
<tr>
<td>3) Learning through evaluating work experiences</td>
<td>3) Learning from other peoples’ experiences</td>
<td>3) Practice includes conflicts and contradictory aims</td>
<td>- theoretical knowledge to be replaced by practical knowledge required at work</td>
</tr>
<tr>
<td>4) Learning through taking over something new</td>
<td>4) Creating one’s own view.</td>
<td>4) Practice involves the shared solving of work-related problems linked with networks outside workplace</td>
<td>- as complementary and often integrated</td>
</tr>
<tr>
<td>5) Learning through formal education</td>
<td></td>
<td></td>
<td>B) Different contexts of education and work.</td>
</tr>
<tr>
<td>6) Learning through extra work contexts.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Further study and practical implications**

The results of this study indicate that suggestions for further study and practical implications can show to many directions. First, as contemporary design work is characterised as technical and social at the same time, further study should address team-based and networked design practices and the constitution of interaction during context-bound design processes (see also Bucciarelli 2003; Button 2000; Ludvigsen, Havnes & Lahn 2003). In addition, the essential role of the subject’s accumulated previous work experience and the social life of working practices should be treated as intertwined. Thus, if the target of vocational education, in the case of designers, is to develop innovative, risk-taking problem-solvers, learning tasks and larger authentic WBL-projects, for instance, should be designed as open-ended, context-bound, respectively.

Second, when approaching workplace learning at the more general level, the question of guidance becomes essential. The results of this study demonstrate that workplace learning is at its best if individual worker’s previous experience, work aims and need for guidance can be taken situationally into account. Consequently, in order to be able to develop the work processes and the guidance of learning, those processes and tasks should be continuously analysed. Further, the role of management is to support all kinds of developmental efforts made in organisations and teams (Järvinen, Koivisto & Poikela 2000). It should be remembered, however, that efforts to improve workplace learning will usually impact unevenly across workplaces and individual workers (see Rhodes & Scheeres 2004). For instance workplace training can also have undesired effects and,
thus, not always hoped by the employer. Consequently, one important question both for further studies and practice is how to develop workplaces as open and flexible learning environments for all.

Better understanding of the processes and practices of workplace learning may also help to develop the guidance of workplace learning periods conducted in vocational education organisations. As indicated in this study, for workers work and education are perceived as very different learning contexts. Work and learning through work was perceived as “real” action guided by the authentic problem-solving situations. Therefore the integration of formal learning and workplace learning seems to be important. On the basis of the findings of the present study, it is suggested that more supportive and participative elements should be included in formal workplace learning practices so that the communal could become as important an aspect of schools’ cultures as it is a natural part of workplace practices.

Acknowledgements: The present paper is part of a larger research project "Integration of Work and Learning: Strategies for Connectivity and Transformation” funded by the Academy of Finland (project number 205922).

References


