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How can a macro-ergonomic framework developed in academia be "transferred" to ergonomic practitioners and become a new work practice? The purpose of this paper is to reflect upon experiences from an interactive research program in which this transferral was tested by two consecutive approaches: "learning by participation" and "learning by doing". The outcome of the two approaches was evaluated by interviews and observations. The paper finds that a successful learning process takes place when: 1) practitioners are included in the research team and take part in the development, test and interpretation of results when applying the new concept to a real case in a company; 2) the concept is introduced to practitioners, after which they try to practice the concept in a normal consultancy situation, and afterwards have the opportunity to reflect upon their experiences in a "learning space" with the researchers and other practitioners; 3) paying attention to the organizational settings of the ergonomic practitioner to make sure that a new work practice is implemented in the organization and not only by a single practitioner.

INTRODUCTION

Much of the academic ergonomics community has stressed for a long period that ergonomists should take part in the design process of work systems. Karwowski (2005) forecasts that design and management of systems that satisfy human compatibility requirements will be the ergonomics discipline's main focus in the 21st century. He envisions a proactive ergonomic design approach that drives technology (Karwowski 2005). Macroergonomics is about the design and optimization of work systems with a focus on the interaction between technology, organization and work system (Kleiner 2004). Daniellou (2005) also stresses that ergonomists should take part in design processes of new work systems. He envisions an active role for ergonomists to influence the management of design projects by setting up new structures that allow the participation of future users (Daniellou 2005).

Consequently, within macro-ergonomics and related disciplines, frameworks, models and concepts have been developed to analyze and design work systems. It is recognized that ergonomics is but one discipline that must act together with engineering and management disciplines in the design process of work systems. While the ergonomic frameworks and tools for analysis and design are well developed, the capabilities and work practices of ergonomics practitioners are less studied. It is especially unclear in what ways ergonomic practitioners should gain the capabilities and ways of working assumed in theoretical frameworks. One reason for this may be that the development of frameworks and methods almost exclusively takes place in academia. The frameworks and concepts are rich in considerations about the role of ergonomists in the design of work systems but poor in explaining how ergonomic practitioners can acquire the necessary capabilities and a new work practice based on the theoretical models and understanding. Therefore, this article focuses on the question: How can ergonomic frameworks and

concepts developed in academia and implying new capabilities and work practices for ergonomic practitioners, become "transferred" to the practitioners and result in a new work practice? In our investigation of this question, we take as a point of departure the work of Schön (1983). His studies indicate that the actual work practice of professionals cannot be seen as a result of the traditional knowledge hierarchy of basic science, applied science, and technical skills (Schön 1983). But if knowledge and capability are not "transferred" along this line, how can ergonomic practitioners learn to practice new concepts developed in academia? In the Danish research programme Workspace Design (WSP) a new framework for ergonomists has been developed. The research programme also specifically addresses the question of how this framework can become a new work practice for ergonomists. This was undertaken in two consecutive approaches. When the framework still was under development the approach was "learning by participation". When the framework was matured, the approach was "learning by doing". The aim of this paper is to reflect upon this strategy and the preliminary outcomes concerning the transfer of the approach to occupational health and safety consultants (OHS consultants) and units. In this way, the paper can contribute to answering the question of how ergonomic frameworks and concepts developed in academia can be learned by practitioners and thereby induce new work practices.

Our findings suggest that a successful learning process takes place when: 1) practitioners are included in the research team and take part in the development, test and interpretation of results when applying the new concept to a real case in a company; 2) the concept is introduced to practitioners, after which they try to practice the concept in a normal consultancy situation, and afterwards have the opportunity to reflect upon their experiences in a "learning space" with the researchers and other practitioners; 3) paying attention to the organizational settings of the ergonomic practitioner to make

sure that a new work practice is implemented in the organization and not only by a single practitioner.

In order to understand the research set-up, a short introduction to the WSD concept is presented in the next section.

THE WORKSPACE DESIGN FRAMEWORK

The idea of the Danish Workspace Design research programme was threefold. First, an objective was to develop a new concept, including methods for ergonomists and consultants in the Danish occupational health service (OHS) who take part in design processes of work systems. Second, this approach and the methods were to be tested in real cases in three companies. Third, the approach and the methods were to be "transferred" to OHS consultants and OHS units in Denmark, thereby making it possible to develop a new work practice and a new service. The role of change agent might be appropriate; however, in the programme we aimed at a more specific role for the OHS consultant, which we designated as "workspace designer".

This role was intended for OHS consultants working with client companies engaged in technological and organizational changes. From the outset, it was not a ready-made concept. The concept gradually emerged on the basis of experiences from two intervention cases. The idea was to set up an interactive research programme in which consultants in Danish OHS units participated by taking active part in the interventions and subsequent evaluation and development of the WSD concept. Hereby, it was hoped that the consultants would be able to bring the concept and methods back to their OHS unit, which could then offer this new approach to clients.

The notion of Workspace Design was inspired by the work of Horgen (Horgen et al. 1999). In this work, the workplace with work practices is seen as embedded in four dimensions: spatial, organizational, financial, and technological (SOFT). See Figure 1.
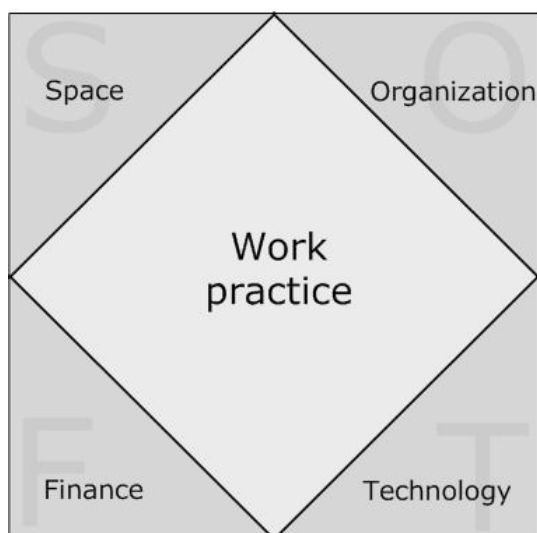

Figure 1. The SOFT model

These dimensions are interdependent and in a dynamic relationship with one another. A change in one dimension may demand changes in others as well. The staging of the Workspace Design process is aimed at creating a dynamic coherence between work and these four dimensions of the workspace. The creation and shaping of workplaces are processes that are influenced by the actors who populate each of the four corners. The basic idea of the concept of Workspace Design was that actors who are capable of working across the four corners are needed, to facilitate and negotiate the process of workplace-making with the different actors. These facilitators stage the Workspace Design process: They are workspace designers. This is a job of creating shared visions among actors with different perspectives and competencies, overcoming resistance and political interests, setting up a collaborative design process, and facilitating meetings between actors from different corners in the SOFT model.

In addition, it is a core feature of the Workspace Design concept that staging the process is based on user participation. This entails methodologies and tools for user participation as important elements of the concept. And finally, the concept is aimed at helping organizations create effective as well as sound workplaces, meaning healthy and safe work conditions and good ergonomics.

The methods and the role of a workspace designer were trailed and further developed in two intervention cases: 1) an industrial manufacturer who was to implement new technology in an empty production hall, and 2) an office in a municipality that was to move to an open space office and implement new ways of working. We had a theoretical idea of the workspace designer's role based on the SOFT model, and we had an existing collection of methods based on the experience gained by the WSD team members from their previous work. It was, however, during the intervention case studies that we gained experience on how to practice the role and use the methods in particular organizational and technological contexts. Based on the experience gathered from two case studies, we developed a model for a workspace designer to intervene in socio-technical change projects (Figure 2). In this model, the workspace designer is seen as navigating concurrently at three different stages.

In setting the stage, the workspace designer investigates and negotiates the frames and networks surrounding the socio-technical change project in the organization. This is typically based on meetings with management and employee representatives. Having the SOFT model in mind, the workspace designer enquires into the status of the change project by asking what in the four corners is open to alternative options and what seems to be closed. The SOFT model also points to relevant actors to be considered as participants in the intervention activities. In this phase, the workspace designer is negotiating with organizational members on the goal of the intervention, the resources to be put into the intervention, who should participate, and how insights and results from the intervention are to be transmitted and sustained in the ongoing socio-technical change project.

The workspace designer has to gain a basic understanding of the work system in the organization or in the relevant part of the organization in question. The issue here is to understand the basic features of the production system, work practices and working conditions. It also includes getting an idea of what is
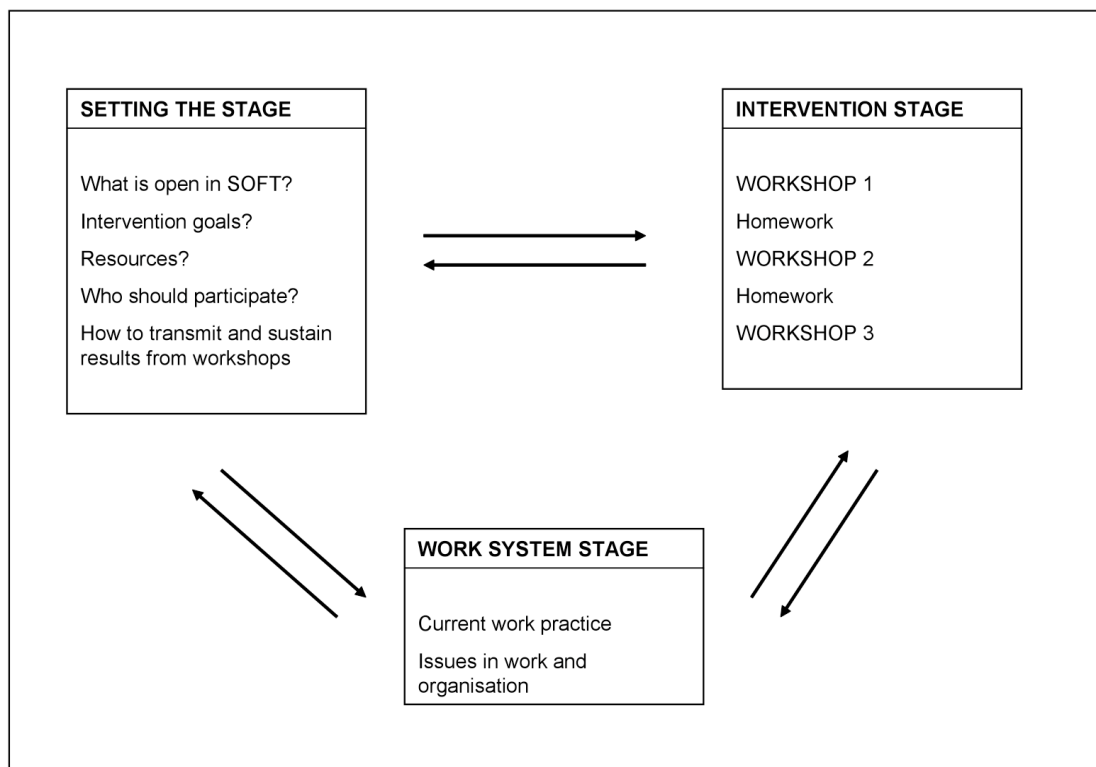
Figure 2. Workspace design stages 1

being debated in the work system, what are the current issues to be solved in the employee / management relations? Obtaining this understanding can be a concurrent process to setting the stage.

METHODS

The two approaches "learning by participation" and "learning by doing" has been evaluated by the researchers in the WSD team, joined by one impartial researcher, in order to establish whether learning had taken place either on an individual or organizational level, and whether the learning has formed basis for a new work practice. The methods chosen were semi-structured interview and observations of the consultants at work. In the case of the interventions – "learning through participation" – the OHS consultants involved in both cases, as well as the management of the consultancy firms, were interviewed.

The "learning by doing" approach was evaluated by interviews and observations in two of the participating organizations (Table 1): 1) the project involving design of a new depot for aids for the sick and elderly were evaluated by interviews with the two course participants, the affected employees as well as visits to the depot before and after the changes, and 2) group interviews were carried out in the organization working with technological changes in production lines.

In the data analysis, we have identified data that indicate that learning had taken place:

1. The consultants themselves state that they have learned something.

2. The consultants report that they applied the framework in other projects.
3. The management states that the concept and methods have spread inside the organization.
4. The management states that the concept and methods will be used in their consultancy services.
5. Other stakeholders evaluate the consultant's new work practice and its effect.
6. We observe the consultants using new methods.

LEARNING THE PRACTICE BY PARTICIPATION

Two interventions were carried out as part of the WSD programme. In both cases, OHS consultants were part of the team that designed and carried out the interventions. In this manner, the WSD concept was tested and simultaneously further developed, using an interactive research methodology.

The first intervention took place in an industrial company that was embarking on a change of production technology, going from outdated, labour intensive, batch production with numerous ergonomic problems to a state-of-the-art, highly automated, continuous production, partly with the aim of eliminating the majority of the ergonomic problems. The OHS consultant normally associated with the company was included in the WSD team, and he instigated the negotiation with the management. In this way, he became a key player in "setting the stage" (Figure 2). In order to ensure the WSD team's awareness of the production and the work practice at the company – the so-called "work system stage" (Figure 2) – a screening of the work environment was carried out by the OHS consultant and a researcher. The researcher chose to approach the screening by following the flow of the production, so that both knowledge of the production and the associated

Table 1. Organizations attending the training course

Organization	Participants	Change project
Industrial company	Design engineer OHS specialist	Design of production machinery
Industrial company	Safety manager Ergonomist	Redesign of production lines
Occupational health service	Two OHS consultants	Layout of open space office
Hospital	Safety coordinator Project manager	Design of depot for aids to sick and elderly

ergonomic problems came to light. This approach is inspired by the walk-through-method (Horgen et al. 1999), which is a combination of an interview and a guided
tour, where the employees systematically walk you through the production while explaining the different elements. The OHS consultant was not accustomed to this approach, and he was surprised at how many new things he also learned about the production just by talking with the employees and following the production flow. This OHS consultant was a novice in the field of macro-ergonomics and WSD and was not familiar with the more creative methods used. Consequently, he took a less active role in the "intervention stage" (Figure 2) and drew on the experience of the other members of the WSD team. Later in the intervention, we carried out what is called a future workplace assessment. In this event, the OHS consultant was asked to take the central role of facilitating the discussion about the future working environment. The OHS consultant was instructed in the method by the rest of the WSD team, and he also took part in writing the "script" for the workshop. The OHS consultant rose to the occasion, became the prime mover of the event, and was able to orchestrate a visually supported dialogue between the different stakeholder groups – employees, management, and engineers – about the working environment of the future workplace. In this way, the OHS consultant used WSD methods to address the ergonomic considerations in an open forum, and in this process developed the skills required for staging a WSD process. Thus, in the first part of the intervention, the OHS consultant worked as a novice workspace designer along side the researchers learning the methods, but in the second part, the OHS consultant worked more independently as a workspace designer.

The second WSD case involved a department in a city council which is undergoing major change, consisting of 1) a reorganization where several smaller departments merge into one, and 2) a physical move from small one- or two-man offices to a newly refurbished office building with an open-plan layout. In this case, too, the OHS consultant normally associated with the council joined the WSD team. However, in this case the OHS consultant had previously worked with similar creative methods and was used to taking a more holistic approach to ergonomic consultancy, which prompted the OHS consultant to play a more active role, especially in the design and the carrying out of the intervention.

Thus, the OHS consultant 1) negotiated the WSD team's access to the change process with the management; 2) designed the intervention alongside the WSD team, thereby ensuring the tailoring of the methods to the specific context of the department, which was well known to the OHS consultant; and 3) functioned as a facilitator at several events. She also played an active role in composing written material, such as booklets describing and interpreting the intervention. Subsequently, the OHS consultant presented the WSD methods at different occasions internally in the city council with the aim of selling the WSD as a consultancy service to other departments undergoing similar changes.

Approximately once a month, the WSD team and the OHS consultants involved in the cases met at a project meeting. These meetings functioned as a space for joint reflection, where the participants could discuss and further develop the WSD concept and its methods.

The evaluation of the first case showed that the work practice had not been rooted in the consultancy firm. There are two main explanations for this: 1) the first consultant participating in the WSD team left the company after a few months, and 2) the consultancy firm apparently viewed their participation in the research programme more as a work task like any other and not as a possibility to learn a new approach to ergonomist consultancy work. The consultant involved in the WSD team also left the company to be able to work with a more holistic approach to ergonomics in line with the WSD concept. However, the company has since shown some commitment towards the project. They have held a workshop for consultants and clients about the new concept. At this occasion, it became clear that several of the firm's clients were interested in this kind of consultancy service.

The OHS consultant in the second case has partly succeeded in incorporating the concept and methods in her consulting firm's service portfolio. It was apparent that she had learned a great deal from participating in the WSD team, and she tested some of the methods in her own work. In so doing, she also initiated her colleagues into the concept. However, our interviews with her and the management of the consulting firm indicate that although the consultancy firm had been inspired by some of the more creative, visually based methods developed in the research programme, and they have used these methods in different projects, we have not been successful in including some of the more basis principles behind the WSD concept in the local theories of the company. Thus, no organizational action has taken place, and the WSD concept in its totality has not yet been included in the company's approach to ergonomic consultancy.

LEARNING THE PRACTICE BY DOING

When the WSD concept had matured and been developed during the interactive research interventions, the WSD team sought new ways of "transferring" the new work practice to a larger audience. The WSD team offered a training course to ergonomic professionals, such as OHS consultants. The course was advertised in various media and the response was overwhelming. The training course was planned to proceed in four steps: 1) participants prepare for the course, 2) one day in the workspace lab, 3) participants working with an assignment from their organization, and 4) one day in workspace lab

Table 2. The structure of the training course

Participants' organization	Workspace Lab
Prepare by complete the booklet	
	Course day 1
Working with WSD methods in an assignment	
	Course day 2
Post card	

(Table 2).

Four companies were chosen to participate, based on submitted applications describing a future change project in the company (Table 1). Each company participated with two representatives. Two companies were major corporations from the private sector with their own internal OHS advisors. One company was an OHS consultancy firm. The two last participants were from a Danish hospital, a safety coordinator and a project manager. The course was designed as a combination of traditional education and contemporary training in which the participants take a more active role. In advance of the course, participants were asked to fill out a booklet preparing them for the course. The booklet consisted of three elements: 1) a page where the participants should summarize their experience with project engineering and the planning of large change processes; 2) a so-called workbook (Horgen et al.1999) in which the participants should photograph six different motifs that depict central problems of the workplace; and 3) subsequently comment on the pictures using a colour code (red indicating problems, green indicating good solutions, and yellow pointing out areas in need of special attention).

The last element of the booklet was inspired by the SOFT model (Horgen et al. 1999) (Figure 1). The participants used the SOFT model to analyse their projects, for instance in order to identify the key stakeholders occupying the four corners.

The first day of the course focused on design, alternating between group work and presentations by the WSD team about the theoretical foundation of the WSD concept as well as reports from the two interventions. In the group work sessions, the representatives from one company worked with representatives from another company, forming two groups. The group work was facilitated by members of the WSD team, and the organization of the group work was inspired by WSD methods such as design games, which emphasized creative, visually based means of communication (Seim 2007). In the first part of the group work, the participants presented and explained their project, using the booklet they had filled out. In the afternoon of the first day, the participants helped each other design a plan for their company project built up around WSD methods that were tailored to their company's specific context.

In the month between the two course days, the participants carried out the plan, working in practice with the WSD methods in their own real-life projects. The main purpose of the second course day for the participants was to report and discuss their experiences with the methods and jointly plan the further steps to be taken in the different projects. This plan allowed the participants time for reflection. Their thoughts and reflections were written down on post cards, which the participants wrote to themselves. For instance, they could write about their experiences using WSD, or how they planed to use WSD methods in the future. The post cards were sent to the participants approximately one month after the course. This was done in order to remind the participants about the thoughts they had at the end of the course; this was to emphasize the idea that the learning that took place during the training course was supposed to manifest itself in the daily work of the participants.

The training course took place in the Workspace Lab. Once again, the lab functioned as a physical and mental space for reflection and experimentation; here, the course participants could learn, plan and discus the WSD concept and methods in a setting separate from their own organization.

The evaluating interviews carried out in the hospital case showed that the participants had not only been able to design and execute a WSD-inspired change process, but they had also been able to tailor the methods to the context in which they were applied. They were able to design an intervention with a series of events – among them two workshops in which they staged a meeting between the architect, employees and management of the aid depot. They facilitated these meetings using the visually based method of WSD. They also visited the aid depot in order to familiarize themselves with the work procedures. These actions show that the course participants had learned the basic principles behind the WSD concept, and they were able to work on all three stages at which a workspace designer operates (Figure 2). Afterwards, they also expressed the wish to apply the methods in other projects, and they included their own descriptions of the WSD methods in the hospital's OHS handbook. This indicates a change in the local theory towards inclusion of their own version of the WSD concept and methods. Both the employees and other stakeholders involved in the change process expressed satisfaction with the new approach taken in the design of the aid depot.

The group interview with the participants from the corporation working with production lines revealed that the course participants had not been able to apply the WSD methods in their own company. The employees have thus not been involved in the redesign of their workplace. Several ergonomic problems were indentified after the implementation of the new production line. The participants had met numerous barriers, when they tried to involve the employees in the project using WSD method. Their own analysis of the sequence of events was that the main barrier was the organizational culture in the corporation, which is characterized by a technical rational approach to change projects in which the predominating actors were engineers in the technical department. This case clearly demonstrates the importance of the phase of "setting the stage" (Figure 2), when all involved parties have to be committed to the approach to the change project.

LEARNING A NEW ERGONOMIC WORK PRACTICE

Both ways of "transferring" the WSD concept and methods from academia to ergonomic professionals are in line with Lave and Wenger's (Lave & Wenger 1991) theory of learning as participation in situated practice.

The WSD team as a community of practice

In the approach used in the WSD cases – learning by participation – the WSD team gradually formed a heterogeneous community of practice (Wenger 2000). When the WSD team was initially formed, the situation could be described as a meeting between different communities of practice; but as the team members worked together in developing the concept and methods, the process of establishing a community began. The researchers' and the consultants' sense of belonging to the community developed concurrently with the development of a common intention, their engagement in the project, and the mutual repertoire. The common intentions behind the project were maintained and simultaneously developed during the project meetings, where everybody contributes with information and takes active part in discussions and decision-making. The feeling of engagement towards the community increases over time, concurrently with the development of WSD methods and our mutual success stories.

In the WSD community, OHS consultants were engaged in testing and developing the WSD concept, side-by-side with the researchers in the two cases. Thus, learning was entwined with participation, and the OHS consultants became full members of the community of practice, not by learning about the practice but by actively participating in it. The community itself defined what constituted legitimate practice (Fenwick 2006); thus, the researcher and the OHS consultants shaped the practice together. In this way, the legitimate practice comprising the WSD concept and its methods was based on both theoretical research and the practical ergonomic knowledge of the OHS consultants. However, the development of the WSD team community was not completely symmetrical; from the start, the set-up favoured academia. The consultants had more to learn from the researchers than the other way around. It was the knowledge of the researchers that constituted the basis upon which the WSD concept was built. During the interventions, the consultants moved from the periphery of the community to become full members of the community. This process demonstrates the asymmetrical relationship between the researchers and the consultants. However, the intention had never been a symmetrical relationship between the researchers and the consultants. While the researchers were responsible for project management and the research process itself, the practitioners were responsible for their own learning and the devolvement of the framework back to their home organization. In retrospect, sufficient time was not spent on the role definition phase in this project.

The OHS consultants as boundary spanners

The consultants belonged to (at least) two different communities of practice: the WSD team and their own organization. In Wenger's optic, the boundaries of communities are particularly important to insuring learning. Boundaries are areas where perspectives meet and new possibilities and radical new insights arise. When members of a community interact with another community, they are exposed to a different type of competence, which results in reconfiguration of the relation between experience and competence (Wenger 2000). The consultants' membership in the OHS consultant community gave new dimensions to the repertoire of the WSD team community. But it also gave the consultants an important role as boundary spanners, functioning as brokers between the communities. Thereby, experiences from the consultancy world could inform the knowledge creation inside the WSD team, and the knowledge created by the WSD team could be made accessible to the OHS consultancies.

The training course as a social learning system

In case of the WSD training course – learning by doing – a more conventional way of learning was adopted in the presentations, but the notion of situated learning was manifested in the emphasis on group work and the implementation of the concept in practice by the participants. At the two course days, the WSD team's community of practice met other communities – the course participants – thereby forming a social learning system. According to Wenger "the learning and innovation potential of a social learning system lies in its configuration of strong core practices and active boundary processes" (Wenger 1998). The core practice – in this case, the WSD concept and methods – had already been configured and tested by the WSD team. The participants' own project, where they planned and carried out a WSD project in their own context and were supervised by the WSD team, constituted active boundary processes. Specifically, the movement to and from the mental reflection room in the workspace lab and the real-life context of their own change project (Figure 4) demonstrated these active boundary processes; in the workspace lab, they were able to reflect upon the usefulness of the WSD concept in their own context. In this manner, we had designed the training course to underpin situated learning.

The course material as boundary objects

The material used in the course – the preparation booklet, the game board used in group work etc. – was designed to facilitate the dialogue between the participants and the WSD team. Thereby, these objects became boundary objects supporting the learning process across the boundary between the communities. In our experience, visually based tools work very well as boundary objects because of the equalizing effect of visually grounded communication (Seim 2007). An example of this is the group work where the dialogue was structured using a game broad depicting the SOFT model.

DISCUSSION

The starting point of this study was the question of how ergonomic frameworks and concepts developed in academia can be learned by practitioners and thereby induce new work practices.

Our findings can be seen as a development along the lines of two Dutch studies. When comparing the strategy for "transferring" knowledge in the Workspace Design research programme with these two Dutch studies, a pattern can be seen: In the study by Swuste and Arnoldy (Swuste & Arnoldy 2003), the focus is on learning a concept already developed in

research: The new work practice is learned in the classroom and real-life situations are simulated through role playing. The participants are not involved in the development of the concept, and they are not trained in implementing the concept in real life. In the second study, Commissaris et al. (2006) use the practitioners as a sort of interactive informant – the researchers adapt an existing theoretical model, based on comments by the practitioners. The focus is on integrating the knowledge and experiences of the practitioners in the adaption of a change concept. Hence, this approach is more interactive than the approach by Swuste and Arnoldy (2003). Neither Dutch study evaluates how the ergonomists' work practices have changed.

The WSD research programme attempts to take the learning approach a step further by focusing on 1) the interactive development of the concept and methods, 2) the situated learning of the concept, and 3) identification and evaluation of a changed work practice. Our findings suggest that two phases should be distinguished in learning a work practice based on a new framework. In the first phase, when even the researchers are not able to formulate the framework explicitly, the idea of "learning by participation" is a useful way for practitioners to gradually learn to know the framework. In the other phase, when the framework is more mature, our findings suggest that it can be learned by "learning by doing".

Commissaris et al. (2006) conclude that the involvement of ergonomists is crucial if a new framework has to be applicable to ergonomics practice. Our findings suggest that a specific sort of involvement is beneficial: the active participation of ergonomic practitioners in the phase of development and trial of the new framework. This invokes for the practitioner a situated learning approach and offers at the same time reflection with the researchers regarding practice. In the city council case, we have strong indications that the OHS consultant learned to practice the Workspace Design framework. After her participation in the programme, she was able to practice the framework in her own assignments. Once the Workspace Design framework was developed and tested, we tried to see if it could be learned in a training course for ergonomic practitioners. This approach was very successful for one out of four training teams. The hospital training team had the freedom to test the Workspace Design framework in their organization, and they were very skilful in doing so. However, in the case of the industrial manufacturer, the training team had difficulties in applying the framework to their organization. This case clearly demonstrates that the success of a training course depends not only on individual learning, but also on the capability of the practitioner's organization to adapt to a new framework and the practitioner's ability to persuade the organization to do so. The participants themselves named the organizational culture to be the main barrier to applying the new work practice. As mentioned earlier, this culture is dominated by a technical-rational approach to changes, with engineers as the primary change agents. In order to root the new work practice in this specific organization, another strategy might have proved more successful; a representative of the engineers from the technical department could have attended the training course together with the safety coordinator. In this manner, the specific culture of the organization would be taken into account, and it would thereby become more likely to affect local theory.

Social learning

We have interpreted our approach in terms of social learning theory, as presented by Lave and Wenger (1991) and Wenger (2000). Both the "learning by participation" and the "learning by doing" approaches accentuate "learning" rather than "teaching", thereby acknowledging the social process of acquiring new knowledge. The interaction between researchers and practitioners in the early phase is well understood as an attempt to create a Workspace Design community of practice based on asymmetrical roles between researchers and practitioners. By looking at the practitioners as boundary spanners between the emerging Workspace Design community and the community of practice in their own consultancy organization, we became aware of an important aspect. We did not fully recognize what would happen when the ergonomic practitioners returned to their own organization and tried to introduce a new framework and work practice. A single practitioner may learn the Workspace Design framework, but in order to change the local theories in the organization and spread the framework may be difficult, as we observed in one case. Hence, in future programmes aimed at learning a new work practice, it is important to take into account the organization in which the practitioners are situated. The local theories and the organizational politics will influence the possibilities to adopt a new framework. We suggest that the management of the organization be closely involved when entering into a contract between researchers and practitioners, which can ensure that the organization engages in the new framework learned by one of its practitioners. Regular, structured contact between the research team and management is also crucial in order to challenge the local theory of the organization over a period of time and also give organization management the possibility of informing the interactive development of the framework so that the final concept fits the organization better.

Implications of the findings

This study contributes knowledge to academic researchers who develop new ergonomic frameworks aimed at practitioners. It is recommended from the outset to think of the learning process that should enable ergonomists to apply the new framework. Based on the findings in this study, we suggest a two-phase model. In the first phase, the ergonomists participate in the development and trial of the framework. Situated learning is important, in combination with reflections on practice. In order to induce organizational learning, it is important to enter into an agreement with the management of the organization to which the ergonomist belongs. The result of the first phase is a more mature description of the new framework. In the second phase, the mature framework can be learned through the "learning by doing" approach in a real-life assignment. Again, it is important that the researchers allow space for reflection regarding practice.

Limitations

The Workspace Design programme has primarily focused on the development and trial of the new framework. Therefore, collection of data regarding practitioners' learning of the new

work practice has been limited. A dedicated study on the learning processes, and especially the outcomes, would have strengthened the results. However, compared to the two Dutch studies, this study secured empirical data to evaluate the learning effects of the activities in the programme.

Further research

Further studies are needed on how ergonomic practitioners can learn work practices related to new ergonomic frameworks. The ergonomist's role as a change agent is widely acknowledged within the ergonomics community. However, how to learn this role in practice needs further study. It seems especially important to study further how a new, individually learned work practice can be transformed into organizational learning in ergonomic consultancy firms or departments.

CONCLUSIONS

The research programme, Workspace Design, has actively addressed the question of how to "transfer" the knowledge created through research to practitioners as an integrated part of the research set-up. The strategy chosen had two phases: In the "learning by participation" approach, the concept was developed and tested in an interactive research design, where the practitioners worked along side the researcher. At a later stage of the programme, after the concept has matured through the interactive process, the "learning by doing" approach can be applied. Both approaches acknowledge the social process of acquiring new knowledge and accentuate "learning" as an active process, instead of the more passive role awarded the student in a "teaching" situation.

The evaluation of the strategy chosen to "transfer" knowledge created in academia to practitioners in the Workspace Design programme has identified three factors that are essential for the learning process: 1) the interactive research set-up, where the practitioners are included in the research team and take part in the development, testing, and interpretation of results from applying the new concept to a real case in a company; 2) the possibility for the practitioners to practice the new concept in the normal consultancy setting and reflect upon their experiences with other consultants and researchers; and 3) the focus on the home organization of the practitioner, so the newly developed work practice is not only practiced by one, isolated consultant but becomes rooted in the local theory of the organization. We believe that these three factors are applicable to other research programmes and can have a more generic use for ensuring the "transfer" of knowledge developed in academia to practitioners.

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