Learning without Interrupting

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Abstract - Learning is a by-product of working when a problem, question or curiosity occurs during everyday work processes. Thereby interpersonal help seeking is a commonly used learning strategy to acquire missing knowledge. Although the help requesting party benefits from other’s help, helping people are interrupted in ongoing work processes. This correlation of work-integrated learning and unplanned interruptions can be addressed by providing support for interpersonal help seeking. Based on a generalized model of contextualized knowledge transfer, three different approaches are introduced to support the learning without interrupting others.

Index Terms - Collaborative Learning, Contextualized Knowledge Transfer, Knowledge Work, Work-Integrated Learning

I. INTRODUCTION

Learning is an integral part of work activities. Thereby people typically learn from others or from knowledge resources available at their workplace and within their physical and virtual work environment [1]. Common self-directed learning strategies which relate to collaborative learning are based on the observation of other people’s activities, their results, and relation to own activities as well as on interpersonal help seeking – information which is only partly available when work or learning is not coordinated and carried out face to face.

Studies have shown that learning through interpersonal help seeking is also a major reason for unplanned interruptions of individual work processes, especially when it takes place in an online environment. This strongly influences the productivity and performance of people at the workplace. Only 55% of interrupted people were able to continue with their previous work task [2].

This paper focuses on knowledge working organizations and thus on knowledge workers which finally own the responsibility for their individual work-integrated learning performance. It considers the correlation of work-integrated learning and caused unplanned interruptions in computer-supported interactions. The paper introduces an integrated concept of supporting intra-organizational work-integrated learning activities based on knowledge transfer interactions on the one hand and avoiding interruptions on the other one. The conceptual approach is based on formalizing the process of interpersonal help seeking, providing contextual awareness information about activities of others, their situation and workload from within the workplace environment, and finally on balancing work load and individual stress caused through help requests of others. Further it is shown how the concept was transferred into practice.

II. LEARNING AS AN ASPECT OF KNOWLEDGE WORK

Without an organization-wide strategy for learning at the workplace, each knowledge worker within an organization finds his own ways of work-integrated learning based on available material and human resources. This may result in coordination overhead because different strategies have to be aligned; it may result in not using available resources; it may result in low work-performance because relevant information is not considered etc. Software components may support work-integrated learning within an organization as well as work-integrated cooperative learning of each single knowledge worker within that organization. However, it has to be assistive instead of an additional burden, it has to be easy instead of complicated to use, and it has to consider research results from a variety of different disciplines instead of setting them aside.

Finally, in the focus of work-integrated learning remains the individual – the knowledge worker. Following Machlup [3] a knowledge worker is an employee of an organization whose essential operational and value creating tasks consist in the production and distribution of knowledge. So far, the knowledge worker (as an archetype) has been well characterized with regard to being an adult learner and with regard to his tasks.

With regard to cooperative respectively work-integrated learning the following characteristics of a knowledge worker have to be taken into account:

- Knowledge workers usually are highly intrinsically motivated people.
- Knowledge workers are willing to voluntarily share their knowledge out of moral obligation and community interest [4].
- A knowledge worker is five times more likely to turn to a fellow knowledge worker in order to find information than turning to other sources of information [5].
- Dalkir [6] lists quickness, additional context information and trust into the source of information as reasons of a knowledge worker to contact a fellow knowledge worker.

This information is not universally valid but gives a direction for further research in supporting knowledge workers to perform their everyday work.

III. CONTEXTUALIZED KNOWLEDGE TRANSFER

Interpersonal help seeking is a social interaction between knowledge workers in a workplace environment. Its common goal is the acquisition and transfer of knowledge in order to satisfy the help request. Following Eraut and Hirsh [7] it can also be understood as an enabler for learning activities by providing a means for asking questions, getting information from others, listening and
observing their activities as well as for reflecting, giving and receiving feedback or simply using mediating artifacts in collaboration. Additionally, it supports learning as a by-product of work processes, e.g. when a problem solution is worked out collaboratively or knowledge workers interact in group processes.

To systematically research interpersonal help seeking and identify approaches which support this commonly used learning behavior [1], the contextualized knowledge transfer model has been developed. This model provides a process-oriented as well as knowledge worker centered framework for describing roles, activities and information flows in interpersonal help seeking.

The next sections give an overview of the process model part, and they introduce different approaches to support work-integrated learning which takes place in collaborative interaction of knowledge workers:

- **interaction scripts** are described as a meaning to provide guiding and structuring support during interpersonal help seeking,
- **contextual awareness information** is introduced as an crucial requirement to support the management of coupling knowledge workers (while reducing unplanned interruptions) and help to align their activities, and
- **work load balancing** is a technically oriented approach, which finally deals with improving the performance of interpersonal help seeking and reducing the interruption of busy knowledge workers.

The different approaches are set in relationship to the formalized process model of knowledge transfer interactions, a more generalized model which help to describe interpersonal help seeking.

A. **Formalized knowledge transfer process**

The knowledge transfer interaction is central part of the proposed model of contextualized knowledge transfer. Its formalization is required in order to identify, understand, and finally support social interactions in workplace learning. The proposed process model describes roles, activities and process steps of contextualized knowledge transfer which are used later to derive conclusions on support mechanisms.

The interaction process involves two knowledge worker roles:

- **knowledge seeker** interact in order to request help from others and acquire new knowledge, whereas
- **knowledgeable persons** provide the required knowledge and assistance in problem solving or knowledge acquisition.

Starting point for knowledge transfer interactions is typically a problem or question to be discussed between the knowledge seeker and knowledgeable person to be contacted [1]. In the following, it is described as a process, subdivided into three phases:

- The **pre-interaction phase** contains different process steps necessary to prepare the knowledge transfer between two or more knowledge workers. The request interaction step describes activities such as the preparation of a request artifact containing a question or problem as well as additional explanations, urgency and privacy statements. The negotiate interaction step describes activities carried out to reject, agree or re-schedule the interaction. And the refine request step describes activities such as the problem formulation or refinement.

- The **interaction phase** contains two steps necessary to perform interaction between two or more knowledge workers: The perform interaction activities step describes activities such as the initiation of interaction tools the interaction partners agreed to use, execution of interaction activities (communication, coordination, collaboration) as well as logging of interaction activities and results. The suspend interaction step describes activities carried out to suspend or re-schedule the interaction, and to store logging as well as documentation artifacts.

- The **post-interaction phase** contains three steps necessary to be performed by at least one knowledge worker in order to prepare the results of interaction for future use: The give feedback step describes activities such as giving feedback on the interaction’s quality and success. The reflect interaction step describes activities carried out to process the logging and documentation artifact in order to create and review a reflection artifact. The review outcomes step describes activities such as reviewing of the reflection artifact by other knowledge workers.

See Figure 1 for a graph model of the contextualized interaction process including phases, transitions and process steps.

All three interaction phases directly correspond to Simons [8] learning functions for self-directed learning. Typical preparatory functions are carried out within the pre-interaction phase, while executive functions are mapped onto the interaction phase. Finally, closing functions are applied within the post-interaction phase. The pre-interaction phase is typically dedicated to prepare workplace learning by getting an overview on the problem/question and knowledge, skills and attitudes needed to find a solution for it. It is also used to identify individual learning goals and adapt learning strategies for the interaction with knowledgeable persons. The interaction planning is another preparatory learning function carried out in this process phase. Workplace learning is then performed within the interaction phase.
through exchanging information with knowledgeable persons, thinking about and reflecting on this information exchange. Other executive learning functions are used to analyze and formulate the learning outcome of an interaction. Finally the post-interaction phase is typically dedicated to close and reflect on workplace learning which has been carried out in interaction with others. Closing learning functions are used to sum up the achieved knowledge and skills, thinking about future use and transfer conditions as well as evaluating the learning process and outcomes.

B. Scripting the knowledge transfer

While interpersonal help seeking is a major source for learning at the workplace, it requires the cooperation of colleagues which can provide missing information or assist in problem solving. In most cases this cooperative process happens spontaneously encouraged through a problem, question or curiosity which occurs in work or learning activities [1]. Then it depends on people’s abilities and experiences whether the interaction leads efficiently to a valuable outcome or not. Here adequate support can help to provide structures and interaction patterns which increase the success probability additionally [9]. Scripting the interaction is one way to improve collaborative learning during interpersonal help seeking on a technical basis [10]. It provides a meta-protocol on how to request help and answer help requests.

Therefore each phase of the knowledge transfer process is structured with interaction scripts in order to support knowledge workers in internalizing their interaction with others as a structured process and guiding them efficiently through single process steps.

![Figure 2. Macro and micro level interaction scripts in contextualized knowledge transfers.](image)

Interaction scripts are provided on macro and micro level [11]. Whereas the macro level script reflects the formalized process model, micro level scripts provide guidance in each process step (see Figure 2). In pre-interaction phase for example, a combination of problem formulating, social and fading script is used to collect all required information for managing the coupling of knowledge workers [12]. With the increasing internalization, fading reduces the amount and quality of structuring support.

Using interaction scripts to support the contextualized knowledge transfer helps knowledge workers not only to understand and internalize their collaborative activities as part of a structured process. It also forces them to focus on their initial problem, question or curiosity without stealing too much time from knowledgeable persons.

C. Providing contextual awareness information

Bardram and Hansen (2004) showed that collaborative working and learning is a major reason for unplanned interruptions in individual work processes [13]. This strongly influences the productivity of knowledge work at the work place. They also argue that knowledge about the current situational state of others helps knowledge workers to align and integrate their own activities in a seamless and highly sophisticated manner with the activities of others even without interrupting them. This practice has been described in literature as social awareness [13–15] or group awareness [12]. While group awareness can be understood as up-to-the-minute knowledge about members of a collaborative group, their activities and the interrelation with own activities; the concept of social awareness additionally focuses on social relations in collaborative groups [16].

In order to avoid the interruption of knowledge workers, it is crucial to provide contextual awareness information which display the work related or even social situation of others in a physical or virtual work environment. Such information is monitored by knowledge workers to gain required knowledge about others, their activities and situation and align their own activities accordingly. A summary of contextual awareness information adopted respectively extended for the contextualized knowledge transfer can be found in Table 1 based on Gutwin and Greenberg (2002) awareness framework [17].

<table>
<thead>
<tr>
<th>Category</th>
<th>Information</th>
<th>Key questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who</td>
<td>Presence</td>
<td>Is anyone in the workplace? Who was here, and when?</td>
</tr>
<tr>
<td></td>
<td>Identity</td>
<td>Who is that?</td>
</tr>
<tr>
<td></td>
<td>Authorship</td>
<td>Who is doing that?</td>
</tr>
<tr>
<td></td>
<td>Availability</td>
<td>Is a knowledgeable person available?</td>
</tr>
<tr>
<td>What</td>
<td>Action</td>
<td>What are they doing? What has a knowledge worker been doing?</td>
</tr>
<tr>
<td></td>
<td>Intention</td>
<td>What is the intention of a collaborative activity?</td>
</tr>
<tr>
<td></td>
<td>Artifact</td>
<td>What object are they working on? What is the current interaction situation?</td>
</tr>
<tr>
<td></td>
<td>Situation</td>
<td>What was a previous interaction situation? What is my and the role of others? What can I expect from other knowledge workers?</td>
</tr>
<tr>
<td>Role</td>
<td>Expectation</td>
<td>What can I expect from other knowledge workers?</td>
</tr>
<tr>
<td>Where</td>
<td>Location</td>
<td>Where are they/is that located in the workplace? Where have they/has it been?</td>
</tr>
<tr>
<td>How</td>
<td>Action</td>
<td>How is an activity happening? How did an activity happen?</td>
</tr>
<tr>
<td></td>
<td>Artifact</td>
<td>How did an artifact come to be in this state?</td>
</tr>
<tr>
<td></td>
<td>Interaction</td>
<td>How can I interact with others? How did/did others interact?</td>
</tr>
<tr>
<td>When</td>
<td>Event</td>
<td>When did that event happen?</td>
</tr>
</tbody>
</table>

In each phase of the contextualized knowledge transfer interaction a certain set of contextual information can mediate hints on the social as well as work related situation of others. In pre-interaction phase the displaying and monitoring of information about the who, what and where of other knowledge workers help to avoid interrupting them when they are busy or not willing to pause their work or learning activities. In this process phase the focus is on providing rich contextual...
information about other knowledge workers and their current situation to support establishing interactions and anticipating the situation of others including their current work load. In consequence this latter social information helps to reduce the amount of unplanned interruptions by explicitly displaying temporal, spatial and situational boundaries for interpersonal help seeking.

D. Balancing the workload

Computer-supported interaction caused by interpersonal help seeking can develop to be a considerable additional workload and lead to cognitive load and mental distress. This fact is observed in empirical studies [1] and theoretically examined, too [18].

In order to avoid additional workload, contextual awareness information can be utilized as described in the previous section. This approach focuses on a social solution. In addition to that, a technically oriented approach can also help to master the problem of additional workload and unplanned interruptions.

In a computer-supported work environment a considerable amount of work is done using the computer. Thus part of the workload which finally leads to cognitive load and mental distress can be observed through monitoring the computerized environment of knowledge workers. Objective indicators are the quantity of processed information, the amount of tasks to be processed, time pressure, etc, while subjective indicators are the quality of information, the individual perception of work for example. Both, objective as well as subjective indicators can overlay each other and multiply the cognitive load.

When interpersonal help seeking takes place using computer-supported work environments, objective indicators can be used to guard knowledgeable persons from additional workload. Only knowledgeable persons who still have the capacity for answering help requests should then be available for contextualized knowledge transfer interactions. All others should be automatically set unavailable. Approaches of detecting the knowledge worker’s work tasks and selecting available knowledgeable persons for an interaction are described more detailed in [19] and [20].

With this technically oriented approach the interruption of already heavily loaded knowledge workers can be avoided. In parallel it is possible to balance the work load between available knowledgeable persons in order to reduce the described effect of prolonged interruptions [2].

IV. APOSDLE: A TESTBED FOR CONTEXTUALIZED KNOWLEDGE TRANSFER

The proposed model of contextualized knowledge transfer has been developed and applied within the European funded project APOSDLE. The goal of the APOSDLE project is to enhance the productivity of knowledge workers by supporting informal learning activities in the context of knowledge workers’ everyday work processes and within their native work environments.

The key distinction of the APOSDLE approach as compared to more traditional online learning approaches is that APOSDLE will provide integrated information and communication technology (ICT) support for the three roles a knowledge worker fills at the professional workplace: worker, learner, and knowledgeable person. This support will be provided within the work environment, and not in a separate learning environment. It exploits synergies between learning and knowledge management by reusing content not originally intended for learning [21].

During two development cycles the conceptual model of contextualized knowledge transfer has been worked out and refined, based on the individual requirements of involved application partners, related research results and accompanying workplace learning studies [1].

Due to the fact that APOSDLE strongly focuses on knowledge work which is carried out in a computer-supported environment, the overall model of contextualized knowledge transfer was implemented in a software application component which guides knowledge seeker and knowledgeable persons. This component – the Cooperation Wizard (see Figure 3) – uses the described scripts for guiding knowledge workers through the structured knowledge transfer interaction. It provides several contextual awareness information elements to keep the collaborating knowledge workers up-to-date about each other.

In addition to that a recommendation of knowledgeable persons depending on the current work task of the knowledge seeker is done.

V. DISCUSSION AND FUTURE WORK

While interpersonal help seeking is a major source for workplace learning through acquiring missing knowledge, it is also a major source for interruptions of work processes of fellow knowledge workers. The proposed conceptual model of contextualized knowledge transfer helps to describe interpersonal help seeking as a systematic process with starting points to avoid such interruptions through organizational, social and technical actions. To reach this goal, the model also proposes to use a combination of interaction scripts, contextual awareness
information, and work load balancing. This combination is investigated within the APOSDLE project. Its evaluation will allow further refinements and enhancements of the overall model as well as concrete statements on the impact and efficiency of proposed actions in real work environments and situations.

In parallel the role of social relationships and behavior in interpersonal help seeking will be investigated to allow a more complete and systemic consideration of knowledge transfer, including interaction pattern and strategies.

REFERENCES


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