Computer support for reflective learning in the workplace: A model

Birgit R. Krogstie  
Dept. of Computer and Information Science, NTNU  
Trondheim, Norway  
birgitkr@idi.ntnu.no

Daniel Wessel, Kristin Knipfer  
Knowledge Media Research Center  
Tuebingen, Germany  
{d.wessel; k.knipfer}@iwm-kmrc.de

Michael Prilla  
Information and Technology Management,  
University of Bochum, Germany  
Prilla@iaw.ruhr-uni-bochum.de

Viktoria Pammer  
Know-Center  
Graz, Austria  
vpammer@know-center.at

Abstract— In this paper we propose a model of Computer Supported Reflective Learning (CSRL) that links the reflection process to supportive ICT. The CSRL model has the potential to support analysis and design of CSRL solutions. It fills a gap that currently exists between theoretical work on reflection and research investigating technologies for reflection support. The model is based on theory, specifically concerning the reflection process, and on empirical work on reflective learning in work life carried out in five different test bed organizations.

Reflection, reflective learning, informal learning, workplace learning, learning process model

I. INTRODUCTION

Reflection is critical to workplace learning because it enables employees to make sense of complex and dynamic situations [1, 2]. Boud et al. [3] (p. 19) defined learning through reflection as “those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciations.” In line with this definition we consider reflective learning to be the conscious re-evaluation of experience for the purpose of guiding future behavior, acknowledging the need to attend to feelings, ideas as well as behavior associated with work experience.

Additionally, reflection is not only an individual cognitive process, but also has a strong social dimension [4-5]. The process of reflection is often accomplished collaboratively by a team or working unit, which has a joint task to perform and therefore shares work-related experience. Work and reflection on work are intertwined [1, 2] – reflection sometimes taking place in the middle of work and at other times with some distance. Reflection on work experience leads to an improved understanding of the experience and allows for deriving implications, conclusions, or lessons learned. Thereby, reflection transforms experience into knowledge applicable to the challenges of daily work. – Reflection and learning thus form a cycle (e.g. [6-8]).

The existence of reflection “tools” like project debriefings [9, 12] in industrial settings demonstrates the value of reflection in work life. However, to date most reflective learning at work occurs without support of technology [10]. We believe that technology has a huge potential to increase the efficiency and impact of reflective learning at work. This belief is supported by existing research (e.g. [14-18], mostly in the area of education). Lin et al. (1999) for instance suggest that technology can support reflection by providing process displays, -prompts and -models combined with forums for social discourse. Technology support can also be applied to informal, everyday learning in the workplace, and the amount of data generated and captured by technology and potentially useful for reflection is growing [19]. The design space of possible solutions is vast and growing with the emergence of new technologies potentially applicable to work settings.

In parallel, from a theoretical perspective we see a need to provide an integrated view on computer support for reflective learning, to be able to address the great variety of reflection needs in different workplaces and consider the different technologies that could meet these needs. A Computer Supported Reflective Learning model should outline how work and reflection are connected, support the description of reflective learning processes and scenarios in different real-life settings, e.g. workplaces, aiding the recognition of differences and commonalities. Also, it should clarify the different roles technology can play in supporting reflection (for an early discussion see [13]). In this way the CSRL model will aid analysis and design of CSRL solutions.

II. A MODEL OF COMPUTER SUPPORTED REFLECTIVE LEARNING

A strong basis of the proposed CSRL model (illustrated in Figure 1) is conceptual work based on the research literature as briefly reviewed in Section I. Of particular importance here is the model by Boud et al [3]. Additionally, the CSRL model is informed by user and design studies across the five European test bed organizations [10-11]. The organizations include a large neurological hospital, a set of care homes, volunteers in the Civil Protection, a large telecom company, and an IT consultancy company. Our studies focused on the current reflection practices and reflection needs in the test beds. User requirements were developed in collaboration between test beds and technology providers and formulated as scenarios of use of proposed solutions [11].

Our model is shown in Fig.1. The middle part, e.g. the rounded rectangles connected by arrows, provides a
reference reflection process model, while the boxes labeled 1-12 describe categories of tool use. In a specific case of reflection some of the elements in the model may be left out as the model is intended to be generic across different cases, covering individual as well as collaborative reflection, and spanning from the spontaneous, quick reflection closely integrated with work to scheduled reflection activities distinct from work and explicitly organized in many steps. There are four main steps in the process model: Work, Initiate reflection session, Conduct reflection session, and Apply reflection outcome. These steps form a learning cycle, taking into account that reflection outcomes are applied in the work process. The model thus analytically distinguishes reflection from work, representing the former by a reflection session (a time-limited activity of reflecting – whether short or long, informal or formal, planned or spontaneous) [13]. As indicated by the arrows, there may be multiple iterations in the process, such as when reflection outcomes trigger more reflection within a reflection session.

Each of the four main steps may contain sub steps: The main step Work includes Conduct work task, the activity in which work experience is made, and Monitor work: human self-monitoring during work or monitoring performed by a tool. The main step Initiate reflection session includes Decide to reflect, which covers the cases in which the learner makes a deliberate decision to reflect (e.g. based on an outcome of work monitoring), and Frame the reflection session which covers preparatory activities for reflection sessions such as collecting data, clarifying objectives, organizing time and space for the reflection session etc. The step of initiating a reflection session also applies to spontaneous sessions for which planning is not long and elaborate. Conduct reflection session contains four sub-steps. Make information available for reflection is about providing relevant information on the experience of self or others (Make related experiences available) to Reconstruct work experience, e.g. by aid of data from the work process. Make sense of available information includes Understand meaning of the reconstructed experience to the learner, using the context of their motivations and objectives. Articulate meaning supports the individual’s own understanding of the meaning of an experience and is necessary in a collaborative work setting for participants to understand what the experience means to the others and
what others’ experience means to them. **Re-evaluate work experience** is the solution-oriented part of the reflection session. **Frame the re-evaluation** sets up the structure and criteria if such criteria and structure are needed and not in place. **Critique experience** means arguing or thinking about the pros and cons of alternatives, using various resources. **Reach a resolution** implies deciding on a resolution (e.g. individual insight, group decision). **Plan to apply reflection outcome** is about identifying potential consequences for the work practice in question, and making the outcome shareable with others. **Apply reflection outcome** does not include sub-steps.

For each step in the process model, we have identified associated categories of tool use, shown in the external rectangles in Fig.1. The categories have been inferred from user needs in the reflection process as identified in the requirements and prototyping work in our research project. For instance, for the “Work” step, reflection tools might capture data useful for reflection, e.g. body sensors collecting data on stress. “Make information available for reflection” can be supported by a repository of experiences (e.g. exemplifying typical or similar work situations).

### III. DISCUSSION AND OUTLOOK

The CSRL model in its current state is a reference model presenting a generalized view of the process of reflective learning and its potential tool support. While informed by theoretical and empirical work, the model has not yet been subject to a systematic validation and refinement. Nonetheless, we think that the model is valuable to researchers dealing with computer-support for reflection for analyzing reflection processes and technology support for reflection, as well as for designing technological support for reflection.

Our ongoing and future work includes instantiating the model with real cases of computer-supported reflective learning. This will help us identify the strengths and limitations of the CSRL model and adapt it accordingly. Also, it will test our assumptions regarding the benefits of the model: First, we suspect that analyzing a particular (technological) support for reflection with the CSRL model may help in identifying which kind of support is missing. Second, instantiation may show that one and the same (feature of a) tool supports different reflection steps – and insights can be gained on whether such overlapping is advisable or not. Third, aggregating over many instantiations of the CSRL model it will become possible to cluster "cases" of reflection according to which reflection process steps occur. This again would have significant impact on tool design and predicting which (technological) reflection support is beneficial. Finally instantiations of the model should also cover steps of reflection not supported by tools.

Additionally, we plan to integrate the CSRL model into the design process of software development. Lessons learned from this activity will be used as input to defining an associated set of design and deployment guidelines, leading towards a framework for the design and deployment of CSRL solutions.

### ACKNOWLEDGMENT

This work is partially funded by the project "MIRROR - Reflective learning at work", funded under the FP7 of the European Commission (proj. no. 257617) and the Know- Center, funded within the Austrian COMET Program.

### REFERENCES


