COLLABORATIVE REFLECTION SUPPORT AT WORK: A SOCIO-TECHNICAL DESIGN TASK

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Abstract

In this paper, we present work on support for collaborative reflection. So far, most research has been on individual reflection or reflection in educational context and therefore, and little is known on designing support for collaborative reflection. In three studies of using an application for collaborative reflection support, we analyzed usage data as well as material from interviews and observations. Our results show that there were different ways in which the application impacted reflection in the workplace and that besides positive effects we found open issues in reflection support. Based on these results, in the paper we present insights on and design challenges for collaborative reflection support as well as potential solutions for these challenges. We relate these findings to a model of collaborative reflection support and emphasize that support needs to be understood as socio-technical support if it is to succeed in practice.

Keywords: Collaborative Reflection, Workplace

1 Introduction

Reflection is a common part of individual and cooperative work (Kolb, 1984), e.g. when workers think about how to improve individual or common work. Reflection can be understood as going back to experiences, re-assessing them in the current context and learning from this for the future (Boud, 1985). It has been described as a necessary attitude for professional practice (Schön, 1983) and as a mind-set to be cultivated in organizations (Reynolds, 1999). However, despite its relevance support for collaborative reflection has not been researched intensively.

Reflection support has mainly been investigated from an individual perspective, not taking sufficiently into account that it often happens among several people (Cressey et al., 2006; Hoyrup, 2004) – e.g. in meetings in which a team reflects on its practice or in discussions in which workers reflect on stressful situations. Such collaborative reflection differs from individual reflection: If people want to reflect together, they have to make experiences explicit, share and compare them in order to collaboratively gain insights for change in future work (Dyke, 2006; Scott, 2010). This needs communication support e.g. for the exchange of experiences and to collaboratively make sense of them (Daudelin, 1996; Scott, 2010). Data on work and descriptions of experiences can help people to objectively and completely remember them, thus supporting reflection on past events (Prilla et al., 2012). The advantage of collaborative reflection compared to individual reflection is that a group can come up with insights going beyond individual results (Hoyrup, 2004; Mercer & Wegerif, 1999). If collaborative reflection is done properly, it also includes the chance for participants to change their work and its coordination together (Hoyrup, 2004; Prilla et al., 2013). However, collaborative reflection comes with drawbacks: If multiple people engage in reflection, the task will possibly take longer (Loo and Thorpe, 2002) and become more complex. In addition, groupthink may occur, in which critical thinking is inhibited or superseded by the views agreed on in the group (Cressey et al., 2006; van Woerkom and Croon, 2008).

Despite its potential to complement existing approaches of work improvement and its ubiquity in everyday work, most existing work on collaborative reflection focuses on specific situations such as project debriefings (Boud, 1985; Kerth, 2001), stems from education contexts (Kim and Lee, 2002;
Scott, 2010), or reduces reflection to an activity triggered by an individual seeking assistance in individual reflection (Yip, 2006). Reflection needs to be understood as meta-cognition not implied by the structure of most task completion, which makes the design of adequate support more difficult. As an example, we found workers to often omit reflection in favour of using time for primary work tasks (Prilla et al., 2012). Therefore, there is a need for structuring and scaffolding collaborative reflection to create meaningful results (Daudelin, 1996; Hoyrup and Elkjaer, 2006). While recent work has shed light on activities of collaborative reflection (Prilla et al., 2012), we found little work on support for sharing meaningful experiences, discussing them making people aware of collaborative reflection possibilities. The work presented in this paper aims to contribute to closing this gap.

2 Designing Collaborative Reflection Support: Related Work

Tools suggested for individual reflection support include learning portfolios or journals (Loo and Thorpe, 2002; Scott, 2010) to write up experiences, and series of images capturing events (Fleck and Fitzpatrick, 2009). These tools capture data that makes reflection possible even some time after the experiences, diminishing memory loss or deviations in perceptions of an event. However, they rely on reflection to happen by itself (in social interaction) and do not further support it.

A recently prominent area of reflection support, in which the focus is on supporting individuals to reflect, can be found in prompting users of reflection tools to conduct certain tasks as part of their reflection. In approaches as described by Isaacs et al. (2013) tools prompt users to reassess documented experiences after different periods of time, which helps users of the tool to reflect and learn about the situations. Reflection prompts may serve multiple purposes in reflection tools, including instruction (how to reflect or improve work), motivation or reminding (of certain activities), coordination (e.g., of communication during reflection) or creating synergy and knowledge integration by merging experiences (Thillmann et al., 2009). Prompts leave the decision whether to react on a prompt to the user, balancing between sustaining freedom and structuring reflection by imposing flexible amounts of structure, and providing effective yet unobtrusive support (e.g., Davis, 2000; Xun & Land, 2004). However, while asking reflection participants questions helps collaborative reflection (e.g., Daudelin, 1996), prompting has not been explored for reflection in groups at work: Insights on prompting mainly stem from research on individual reflection or education settings. Therefore, we do not have sufficient insights whether prompting might work at work.

Collaborative reflection needs communication among reflection partners to exchange experiences, discuss perspectives and agree on common solutions (Prilla et al., 2012). Appropriate support has to take this into account. However, little is known on the design of tools for such support besides generic tools such as shared whiteboards (Kim and Lee, 2002), which are designed for general purposes of collaborative work. Recent work has indicated that there is a need to more specifically support sharing of experiences, making sense of others’ experiences and articulating this understanding (see Figure 1).

![Diagram](image-url)

*Figure 1: Activities in collaborative reflection, and the role of articulation (Prilla et al., 2012).*
Research on collaborative reflection can also draw on existing work on collaborative work support such as sensemaking, group decision support or collaborative problem solving. While there are overlaps with these concepts, collaborative reflection differs from them in certain aspects. Theories and approaches of sensemaking and collective mind (Crowston and Kammerer, 1998; Weick, 1995) emphasize the need to collaboratively reach an understanding of past events, but do not have the strong focus on deriving insights for future work that reflection has. Group decision support systems (Dennis et al., 1988) are about creating decisions on work in teams, but focus solely on decisions and not on other parts of collaboration such as reaching a common understanding (Power and Sharda, 2009). Approaches of collaborative problem solving (Roschelle and Teasley, 1995) use joint spaces to solve a problem together, but have to deal with the problem that information known to all collaborators from the start tends to be followed more than information of individuals, resulting in a “shared information bias” (Baker, 2010). Collaborative reflection, in contrast, needs exchange of perspectives as well as critical discourse among members to create a solution for future work.

Looking at existing work as presented above, we can conclude that there is a lack of insights on how to specifically support collaborative reflection at work. Using a tool for such support derived from earlier work (Prilla et al., 2013; Prilla et al., 2012), we therefore explored the effects of collaborative reflection support at work, particularly focusing on questions such as how people make use of such support, which impact it has on collaborative reflection and how support may be improved.

3 Three studies of collaborative reflection

3.1 The TalkReflection App

Based on earlier empirical work (Prilla et al., 2013; Prilla et al., 2012), the TalkReflection App was built to support collaborative reflection on conversations of staff with others (residents, relatives, third parties). Initial work revealed that this is a relevant topic for physicians and caregivers: both groups talk to relatives (as well as patients, residents and third parties) often, and in many occasions they have to convey bad news such as a patient getting worse or going to die soon. For dementia caregivers, conversations with residents suffering from dementia are particular difficult as residents might act strangely during normal conversations. According to physicians and caregivers difficult conversations are often perceived as emotionally stressful and may affect workers during and after work. Therefore, reflecting on such conversations in a group might help them to better deal with such situations.

Literature shows the importance and difficulty of being able to talk to relatives, as relatives have a high impact on how patients perceive their treatment (Pennbrant, 2013) and as conveying bad news to them is a difficult task (Maynard, 2003). The problem stems from the multitude of ways to handle conversations on diagnosis and related issues (Perakyla, 1998): Medical and care staff need to learn how to adapt their communication style and behaviour to relatives, which needs experience and often must work ad-hoc, e.g. when physicians meet relatives for the first time (Delvaux et al., 2005; Pennbrant, 2013). Training practices such as lectures or role-play can support the acquisition of these skills, but fall short when it comes to learning how to interact with relatives (Delvaux et al., 2005).

The TalkReflection App supports collaborative reflection among workers about conversations by documenting conversations, sharing them with others and individually or collaboratively reflecting on them by commenting on documented experiences. It also supports identifying necessary changes and writing down proposals for them. These features can be described along the steps shown in Figure 1:

Capturing/documenting conversations: The app supports the documentation of conversations and rating them (e.g. how urgently support is needed). If, for example, a physician in a hospital had a difficult conversation, she may write down the course of the talk and what she thinks went wrong, and then rate the conversation as bothering. Figure 2 shows a list of such documented conversations.
Individual reflection: While writing down experiences and by adding personal comments on their own documentation, users may leave initial insights from reflection of experiences in the app. In the example used above, the physician may add a comment that the relative was not well prepared for the message she had to convey to her.

Collaborative reflection: Users may share their documented experiences, they can access experiences shared with them (list view in Figure 2) and they can leave comments on them – in our example a second physician could create a comment describing that she has been in a situation similar to the one described by her colleague and what she suggests to do in such situations. The app shows the number of such comments for each shared document on the right of each entry.

Sustaining outcomes: If the reflection group or a member creates ideas what to change in the future, they can write it down in the app (tab “Outcomes” on top, Figure 2). In our example, the physician may note that colleagues should better inform a senior physician before conducting conversations.

In addition, the app includes features such as creating content anonymously and share it in order to document issues without being responsible to follow up on them, and structure for reflection, assuming that tasks such as creating documentations, commenting on them and thinking about corresponding changes follow a flow of collaborative reflection as described (cf. Prilla et al., 2012).

3.2 The studies

Studies 1 and 3 were conducted in a German hospital dealing with neurological diseases. Study 1 was done in April and May 2012 and lasted 4 weeks; study 3 was conducted in July and August 2013 as a seven-week trial of an improved version of the TalkReflection App in the same hospital (although, due to staff movement to other wards, with different participants). The hospital was chosen to represent a workplace with highly educated staff and medium to high technology exposure (e.g., a hospital information system was used by all staff). We recruited five physicians of a ward dealing with stroke patients, among which there were three assistant physicians aged from 27 to 33 and two senior physicians aged 45 and 52. They used the app mainly to reflect on conversations with relatives.

Study 2 was conducted in November and December 2012 in a British care home specialized in caring for people suffering from dementia. This workplace was chosen to represent staff with lower education, as UK caregivers often do not have special education in their job, and with low technology exposure, as UK care homes are hardly using computers. The group of participants in the study consisted of five caregivers, who had experience in their work from 2 to 25 years and were aged from 27 to 54. Care staff used the app to reflect on conversations with residents, relatives concerned about
residents and wanting to be informed about residents’ condition, and third parties such as social workers and doctors, who need to be informed about residents. The study lasted for five weeks.

3.3 Course and Methodology of the Studies

We conducted all studies in the same way: We introduced the app in a workshop and walked the participants through examples and practical exercises. In the middle and end of the studies we conducted reflection meetings with participants, in which we asked them to use the app to reflect on issues documented in it. In study 3 the head physician organized the mid-term reflection meeting. In addition, a feedback meeting was held at the end of the study – no further instructions on how and when to use it were given. We used different methods complementing each other for capturing data:

Usage analysis: After each study, we analysed usage based on log data (e.g., how many times people read documentations) and items in the app database (e.g., how many experiences were documented).

Observation of reflection meetings: In the reflection meetings we observed how participants used the app for reflection, how they reflected with it and how often they referred to it when reflecting.

Interviews with participants: To get feedback on their perception of the app, we asked the participants to describe their usage to complement the data available from log files and observations in the analysis. The semi-structured interviews lasted about 15 minutes and included questions on how the app affected their work and whether they perceived it to be beneficial, e.g., “Please give an example in which the app was helpful for reflecting on work with your colleagues”.

The observations and interviews were transcribed and analysed with an open coding approach, which was supported by pre-defined codes from the reflection indicators by van Woerkom and Croon (2008) to separate occurrences of reflection from other situations of thinking about past events. Insights were complemented with log data to explain usage as seen from data and vice versa. The total sample size (n=17, five to six participants per study) shows that the studies were designed to be exploratory, that is, to identify design aspects and challenges to be tackled rather than to derive general insights.

4 Results: adoption, usage and role of devices

4.1 Content created with the App in the studies

In both studies, adoption was slow in the beginning and improved gradually. The usage data shows that participants used the app to a certain extent: In study 1, in which due to technical problems usage data is only available for the last 12 days, users created 7 documentations of experiences and 9 comments. In the follow-on study 3 they created 21 documentations and 45 comments. In study 2, participants created 18 documentations and 14 comments (Table 1). All usage figures were lower than initially expected, which can be explained by the short timeframe of the studies, in which the time of adopting the app had an impact. In addition, staff told us that although a difficult conversation may bother people for several days, such situations do not happen daily, resulting in only a few cases being documented. However, even given this fact the usage of comments (in studies 1 and 2) is low and must have additional reasons. Participants explained this mainly with time constraints. They also told us that it was unclear to them at times what certain features would be good for. For example, a caregiver from study 2 told us that they “didn’t know what to write in the comment”. As a result, users may have focused on documenting experiences rather than commenting, like another participant from study 2 stated: “You do not go to the app because you have a comment, but because you have an issue to write down”. The higher number of comments in study 3 supports this, as here the head physician had been actively commenting in the app, showing the value of comments to staff.
4.2 Usage of the app beyond Content Creation

Our analysis reveals that there was more usage than the numbers given above suggest. Table 2 shows data from study 3, which demonstrates this: participants logged into the app 101 times (about 2 times per day for the whole duration of the study) and read documentations 146 times (about 3 times per day on average, 7 times per documentation). This shows that there was an interest in shared documents among staff. However, Table 2 shows an imbalance in using the app among the participants. The three most active users for each category accounted for more than 70% of these actions and there were different ways of using the app: While user 6 had used most features equally, for users 2 and 3 we can see a preference in commenting while abstaining from creating documents (indicated in light grey in Table 3). In contrast, users 4 and 5 created many documents but little comments (dark grey in Table 3). We refer to the former group as “commenters”, while we call the latter “documenters”.

<table>
<thead>
<tr>
<th>Action</th>
<th>U1</th>
<th>U2</th>
<th>U3</th>
<th>U4</th>
<th>U5</th>
<th>U6</th>
<th>A</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log In</td>
<td>17</td>
<td>21</td>
<td>8</td>
<td>5</td>
<td>16</td>
<td>32</td>
<td>2</td>
<td>101</td>
</tr>
<tr>
<td>View Doc</td>
<td>21</td>
<td>33</td>
<td>12</td>
<td>14</td>
<td>20</td>
<td>45</td>
<td>1</td>
<td>146</td>
</tr>
<tr>
<td>Comment</td>
<td>7</td>
<td>5</td>
<td>12</td>
<td>3</td>
<td>3</td>
<td>13</td>
<td>2</td>
<td>45</td>
</tr>
<tr>
<td>Create Doc</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>7</td>
<td>6</td>
<td>0</td>
<td>21</td>
</tr>
</tbody>
</table>

Table 2: TalkReflection app usage in study 3 with users 1-6 and anonymous contributions (A).

Feedback from users explains the figures in Table 2 partly: The “documenters” reported that they had used the app to share relevant cases with their colleagues (“I documented what I thought was interesting for others”), as this was a missing opportunity in their practice. The “commenters” stated that they mainly used the app for communication (“I commented where I thought it was necessary”).

The data also shows that the app was used to a different extent for different steps of collaborative reflection: While it was used for creating, reading and sharing conversations, reading or creating results and commenting was done less (except for comments in study 3). Our observations and interviews indicate that the participants created more results verbally, but did not add them to the app. Underpinning this, three physicians from study 1 reported that they had been more aware of the need for reflection because of using the app, which had led to more detailed conversations about them (“instead of only saying ‘it was difficult’, as stated by one physician). Caregivers from study 2 stated that they had talked more often to younger colleagues about potential problems.

4.3 Different ways of using the app

We found two ways of using the app for collaborative reflection: Using it as a memory aid and trigger for reflection in (synchronous, face to face) group sessions (see Table 3), and using it asynchronously...
for whole reflection cycles (see Table 4) – the latter happened less often. In cases in which it was used as a memory aid and trigger, users often documented experiences soon after they had happened (in order to not forget them) and shared them with others (to trigger feedback).

<table>
<thead>
<tr>
<th>Type</th>
<th>Articulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documented Conversation</td>
<td>„The resident passed away suddenly, had been here long, was liked by all staff. Was ill in the morning and admitted her to hospital. Unfortunately she passed away [there]. This was very distressing to the staff as they felt it would have been more dignified for the client to be in familiar surrounding.“</td>
</tr>
</tbody>
</table>

| Comments               | -                                                                           |
| Documented results     | „After discussing with the homes manager about the staff being upset, it was decided that staff who were most affected get together and discuss thoughts and feelings.“ |

*Table 3: Example of reflection steps documented in the TalkReflection App in study 2.*

These ways of using the app resulted in two different ways of reflecting with the app: When using the tool as a memory aid, people reflected with it during meetings by referring to a case and documenting results in the app. Using it for whole cycles, they reflected with it asynchronously, that is whenever they had time for it and became aware of a topic they could contribute to. The differences in using the app and the preference for using it for the initial parts of reflection activities can be attributed to the preference of participants to discuss complex issues face to face rather than asynchronously and via tools: In all studies participants reported that they preferred talking about issues directly with others.

<table>
<thead>
<tr>
<th>Type</th>
<th>Articulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documented Conversation</td>
<td>“[Patient’s] therapy finished. Again relapse, palliative therapy. Prepared [relatives] for begin of home care, asked to seek professional support for care. Talk was very difficult, parts were not received or blocked out.”</td>
</tr>
<tr>
<td>Own Comment</td>
<td>“[Relative] conveys the feeling it is our fault. (…) Hears for the first time that [patient] is going to die”</td>
</tr>
<tr>
<td>Comment by others</td>
<td>“[From my experience] especially in the first talk it is important to take some time”</td>
</tr>
<tr>
<td>Result</td>
<td>“Problem: Conversation held alone. It should be known that a senior physician can be asked for support”</td>
</tr>
</tbody>
</table>

*Table 4: Example of an asynchronous (full) reflection cycle in the TalkReflection app (study 1).*

5 Discussion: Proposals for Designing Collaborative Reflection Support that makes a difference

The results of the study suggest that the app had impacts on the participants (for example, the amount of read events as shown in Table 2 or the effect on face-to-face communication as described in section 4.2). These impacts not always left traces in the app, in particular concerning the amount of outcomes documented in the app. This means that the communication triggered by the app was often held face-to-face rather than in the app. We conclude from these results that we need to create *socio-technical reflection support* in which tools complement organisational procedures and vice versa if we want to make reflection work at work. As examples of such socio-technical support, we propose to design support for reflection communities for prompting users for action in reflection tools.
5.1 Reflection in small, coherent work groups vs. Reflection in large or remote groups: Reflection Communities

The low usage of communication (commenting) features and the documentation of results in the studies is likely to be a result of the groups chosen for the trials: In all studies, the participants knew each other, they worked together at the same physical location, and there was a culture of talking about issues personally. Besides other, similar statements, one participant of study 3 told us “I already knew most of the cases documented by my colleagues”, explaining that he perceived limited value in documenting and exchanging cases. The fact that in study 3 there were more comments in the app can mainly be explained by the activity of the head physician: This motivated users to use comments to communicate with the head physician, whom they cannot get hold easily otherwise.

Uptake may also have been affected by the imbalance in user activity. While some users being more active than others is natural (Lave and Wenger, 1991), it might kill motivation in small groups: Active users will recognize lacking activity of others, which will in turn decrease the value they perceive in using the app. This is likely to be a matter of scale, as in larger groups with members not being able to talk to each other personally every day tools for collaborative reflection add more value by enabling discussions on experiences remotely. Initial results from follow-up studies, in which the app was used in larger, dislocated groups, support this conclusion (Prilla, 2014). As enough users to create a critical mass may not always be available in organisations (e.g., the hospital ward had eight physicians in total) we propose to enable reflection beyond departments or organizations, enabling workers to reflect in reflection communities of practice (Wenger, 1999). This may also make these tools attractive to other users in the organizations, as it shows how a reflection group can create a better understanding of work. Figure 3 (left) shows a corresponding extension to the model of collaborative reflection.

![Figure 3: Model of collaborative reflection with (left) community support and (right) social and tool-based cycles of collaborative reflection, extending the model shown in Figure 1.](image)

5.2 Reflection in Tools vs. Reflection in Interaction: Prompting users

Our studies show that the benefit of tools for collaborative reflection may always not be completely obvious to workers, which may lead to lacking tool usage. This is not necessarily a problem, as we observed the app to cause more face-to-face reflection as well. However, it is obvious that leaving comments, referring to others’ comments in reflection and having comments at hand when reflecting enables sharing insights with and deriving conclusions in a larger group. To tap from this potential
people need to be aware of tools and their positive effects. As described in section 2, prompting is a valuable mechanism for this in individual reflection support. We thus developed a mechanism for TalkReflection that prompts users to collaborative activities on three levels (see also Table 5):

<table>
<thead>
<tr>
<th>Level of prompt</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Prompting to use a reflection tool (more frequently)</td>
<td>Email or notifications on mobile devices for awareness of tool support, e.g. “Did you recently have a difficult conversation you want to document?”</td>
</tr>
<tr>
<td>2: Prompting for the use of features</td>
<td>Pop-Up or overlay dialogues in applications, e.g. “Have you been in a similar situation? What did you do?” while looking at own notes.</td>
</tr>
<tr>
<td>3: Prompting to leave traces from face-to-face meetings</td>
<td>Notifications on mobile devices or questions as parts of meeting agendas, e.g. a weekly digest asking for recent ideas on how to change work.</td>
</tr>
</tbody>
</table>

Table 5: Prompts to facilitate collaborative reflection in tools.

To make people aware of the value that using reflection tools reflection may have for them, they could be given an impulse to create a documentation of experiences regularly. Prompts here could be used as requests to individuals, reminding them regularly to use tools.

To make the usage of necessary features more likely, features such as commenting on shared experiences or the documentation of results need to be promoted. For example, to promote comments tools may ask users questions they need to answer in the comment. This would help users to express their reflections on experiences and show them the value of commenting.

To allow face-to-face collaborative reflection to leave traces in reflection tools we must overcome situations in which people create ideas and results in face-to-face collaborative reflection but hardly capture insights from this reflection in the tool. This means shifting from traditional means such as minutes or notes taken during meetings to documenting outcomes in reflection tools.

Combining these levels makes the potential of tools for reflection available in practice while leaving enough freedom for face-to-face reflection: Prompts can make people aware of certain options (e.g., by asking them to document experiences), but may also be more strict (e.g., by making reflection part of agendas). They may also create negative effects if users feel bothered by them rather than supported, and too much structure may even harm interaction of participants (Cressey et al., 2006). Therefore prompts need to be as unobtrusive as possible, e.g. not blocking other actions in the tool.

Figure 4: Prompting in the REFLECT app.
As an initial step of using such prompts we implemented the second level shown in Table 5 in the TalkReflection App. Figure 4 shows the resulting mechanism, in which a prompt asks a user whether she has been in a similar situation and provides her with a text field to describe this situation.

6 Conclusion: Designing collaborative reflection support

Collaborative reflection has been found by different researchers to be supportive for informal workplace learning and improvement in various ways (see sections 1 and 2), especially by enabling practitioners to identify potential for improvement in their work together (cf. Prilla et al., 2013). Our studies suggest that tools support such collaborative reflection by enabling users to sustain, share and discuss experiences. However, the studies also show that this usage was not stable, that results of reflection were hardly documented and that users often did not have the time for using the app or did not understand its value. Besides other conclusions, these results indicate that we need to understand collaborative reflection support as a socio-technical support task: In order to make tools work in existing work structures, we not only need to integrate them smoothly into work procedures, but also to design them in a way that brings (existing) social interaction closer to tools and the vice versa. Our proposals of reflection communities and prompting exemplify this by scaling reflection to different user groups (work group and communities) and by bringing tools closer to the social space of users.

On a conceptual level, our work adds to the understanding of collaborative reflection design by adding to existing work the distinction of social and technology-supported levels of reflection (Figure 3, right). In social (i.e. personal) processes of collaborative reflection work leads to individual and collaborative reflection and finally enables the creation of change or results. Here, reflection often works, but – as described above – may lack support and lead to potential of collaborative reflection being lost. Technology-enhanced, tool-based reflection offers support to overcome shortcomings in the social cycle by enabling users to sustain and share experiences or to asynchronously discuss them. Figure 3 shows the social cycle of collaborative reflection in the centre and the tool-based reflection cycle around it. Between the corresponding phases, there are links indicating that from each step in one cycle, the step in the other can be reached. For example, experiences from work may be captured with tools, thus complementing the social cycle. These transitions map to the prompting levels described in Table 5: For example, commenting for collaborative reflection can be fostered by prompting to use features (commenting) more often during corresponding activities in the social cycle.

There are certain limitations to our insights: Our work deals with only a few cases and small numbers of participants and therefore generalizability of the design principles proposed is not given. In addition, there is a need to include content analysis to differentiate different types of contributions and explore – for example – why some are followed up while others are not. Further work will have to deal with this, involving more users and additional means of analysis. In particular, it will have to show whether our design proposals can enhance reflection. The implementation shown in Figure 4 enables such testing and is currently being tested in different workplaces.

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