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

Complete Research

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, little is known on designing support for collaborative reflection. Based on three studies, we describe insights and design challenges for such support and show that successful support for collaborative reflection needs to take into account the socio-technical nature of this process.

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, and when peers help each other to understand and change practice. 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), and has been described as a necessary *attitude* for nowadays' 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 discussed intensively.

Reflection support has mainly been investigated from an *individual* perspective, not taking sufficiently into account that it often happens among several people (Cressey, Boud, & Docherty, 2006; Steen Hoyrup, 2004) – e.g. in meetings in which a team reflects on its practice or in discussions in which workers mutually 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, collaboratively gain insights and create a ideas for change in future work (Dyke, 2006; Scott, 2010). This needs communication support e.g. for the exchange of similar experiences and to collaboratively make sense of them (Daudelin, 1996; Forneris & Peden-McAlpine, 2006; Scott, 2010). In addition, data on work and descriptions of experiences help people to more objectively and completely remember them, supporting reflection on past situations (Prilla, Degeling, & Herrmann, 2012). The advantage of collaborative reflection compared to individual reflection is that a group can come up with insights going beyond individual results (Steen Hoyrup, 2004; Mercer & Wegerif, 1999). If collaborative reflection is done successfully and properly, it also includes the chance for participants to change their work and its coordination together (Steen Hoyrup, 2004). However, collaborative reflection success cannot be taken for granted, as it comes with drawbacks: If multiple people engage in reflection, the task will possibly take longer (Loo & 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 & Croon, 2008).

Despite its potential and ubiquity in everyday work, most existing work on collaborative reflection either focuses on specific situations of collaborative reflection such as project debriefings (e.g., (D. Boud, 1985; Kerth, 2001)) and education contexts (Kim & Lee, 2002; Scott, 2010)), or reduces it to an activity triggered by an individual seeking assistance in individual reflection (e.g., (Yip, 2006)). The fact that reflection usually is not an integral part of the actual work but takes place on a meta-level makes the design of adequate support more difficult: Since such meta-cognition is not implied by the structure of most task completion, workers often omit reflection in favour of using time to explicitly step back from work and reflect together. Successful reflection therefore needs impulses to make

people aware of the possibilities to reflect and to initiate reflection, which may be given by other reflection participants, who can share relevant experiences that trigger certain reflection. In many other cases, there is a need of structuring and scaffolding collaborative reflection to create meaningful results (Daudelin, 1996; S Hoyrup & Elkjaer, 2006). While recent work has shed light on activities involved in collaborative reflection (Prilla et al., 2012), we found little work on support for sharing meaningful experiences and discussing them and awareness for collaborative reflection.

2 Designing Collaborative Reflection support: related work

2.1 Individual reflection support

Tools investigated for reflection support include learning portfolios or journals (Loo & Thorpe, 2002; Scott, 2010) containing a write-up of learning and other experiences, series of images capturing experiences during a certain event such as SenseCam (Fleck & Fitzpatrick, 2009). These tools capture data that makes reflection possible even some time after the experiences reflected on happened, diminishing memory loss or deviations in perceptions of an event after some time.

A recently prominent area of reflection support, in which the focus is on supporting individual to critically re-assess experiences (that is, reflect), can be found in *prompting* users of reflection tools to conduct certain tasks as part of their reflection. In approaches like (Isaacs et al., 2013) tools prompt users to reassess documented experiences after different periods of time, which helped users of the tool to reflect an learn about the situations. Such prompts can be understood as a "facilitation intervention" (Santanen, Briggs, & Vreede, 2004). They complement tools as described above and have been found to serve multiple purposes in reflection support, ranging from *instruction* (how to improve work), *motivation* or *reminding* (of certain activities), *coordination* (e.g., of communication during collaborative reflection) or *creating synergy* and *knowledge integration* by merging of experiences (Thillmann, Künsting, Wirth, & Leutner, 2009), leaving the decision to the user whether to react in a prompt or not. They have therefore been discussed to balance between sustaining freedom and structuring reflection by imposing flexible amounts of structure, thus providing effective yet unobtrusive support (e.g., (Davis, 2000; Xun & Land, 2004)). However, while it has been shown that asking reflection participants questions can help collaborative reflection as well , prompting has not been explored for reflection in groups at work: The majority of insights on prompting stems from research on individual reflection or from collaborative scenarios in education. Therefore, we do not have sufficient insights whether prompting might work at work and how it would fit in the primary work processes of workers. Too much structure for collaborative reflection may even harm interaction of participants as "reflection is a complex, multifaceted and messy process that is tamed and domesticated at the risk of destroying what it can offer" (Cressey et al., 2006).

2.2 Collaborative Reflection Support

Collaborative reflection differs from individual reflection in that it 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 & Lee, 2002), which can be used for collaborative work purposes in general. Recent work has indicated that there is a need to support the sharing of experiences, make sense of others' experiences and articulate this understanding to support collaborative reflection processes (see Figure 1).

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 certain overlaps with these concepts, collaborative reflection differs from them in certain aspects. Theories and approaches of *sensemaking* and *collective mind* (Crowston & 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, George, Jessup, Nunamaker Jr, & Vogel, 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 & Sharda, 2009). Approaches of collaborative problem solving (Roschelle & Teasley, 1995) use joint spaces to learn together how to solve a problem, 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 experiences and perspectives as well as critical discourse among members to create a solution for future work.

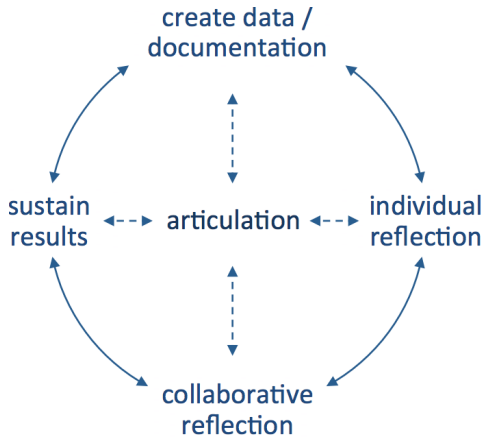

Figure 1: Activities in collaborative reflection, and the role of articulation (Prilla et al., 2012).

3 Three studies of collaborative reflection

3.1 The REFLECT App

Based on earlier empirical work [references omitted for blind review], the REFLECT[1] 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 care givers: both groups talk to relatives (as well as patients or 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. In the case of caregivers, conversations with residents suffering from dementia are also difficult, as they might act strangely during normal conversations. While according to physicians and caregivers difficult conversations do not happen multiply during the day, they are often perceived as emotionally stressful and may affect workers during and after work. Therefore, they explained that 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 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): Physicians need to learn how to adapt their communication style and behaviour to relatives, which needs experience and often needs to work ad-hoc, e.g. when physicians meet relatives for the first time (Delvaux et al., 2005; Pennbrant, 2013).

[1] The name of the app has been changed by the authors to ensure anonymous review.

Usual training practices such as lectures or role-play support the acquisition of these skills, but fall short when it comes to learning how to interact with relatives, (Delvaux et al., 2005).

The REFLECT App *collaborative reflection among workers* about conversations by enabling the documentation of conversations, individual and collaborative reflection on them by commenting on documented experiences. This helps workers to explicate, share and reflect on experiences from conversations. In addition, it supports identifying necessary changes and writing down proposals for them. These features can be described along the articulation steps shown in Figure 2:

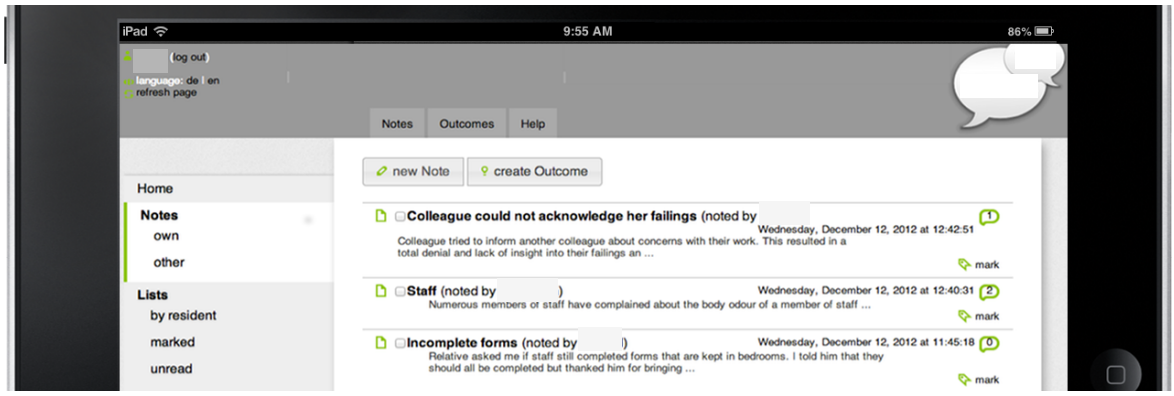

Figure 2: The REFLECT App showing the list of documents entered by staff from study 2.

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 she thinks went wrong, and then rate the conversation as bothering. Figure 2 shows a list of such documented conversations.

Individual reflection: During the phase of writing down experiences and by adding personal comments on their own documentation, users may leave initial insights from the reflection of their experiences in the app. In our example, 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 with a figure 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 conversations.

Besides this support, the app includes convenience features such as a list of documentations associated to a certain resident code to improve care for this resident and it allows users to create content anonymously and share them to document issues without being responsible examples of using it for certain to follow it up. It also provides structure for collaborative reflection, assuming that tasks such as creating documentations of experiences, commenting on them and thinking about corresponding changes follow a flow of collaborative reflection as described e.g. in Prilla et al. (2012).

3.2 The studies

Studies 1 and 3 were conducted in a German hospital dealing with neurological diseases. S*tudy 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 REFLECT 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.

The trial of *study 2* was conducted in November and December 2012 in a British care home, which has specialized in caring for people suffering from dementia. This workplace was chosen to represent staff with lower education, as caregivers are often employed without special education in their job, and with low technology exposure. 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, who are concerned about residents and need 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

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

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 personal usage to complement the data available from app content, log files and observations in the analysis. 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 reflection indicators as described by (van Woerkom & Croon, 2008) to separate occurrences of reflection from other situations of thinking about past events. Insights were complemented with log data, e.g. to compare statements on the frequency of app usage with login data. Although we gathered a lot of material, the total sample size (n=17, five to six participants per study) shows that the studies were designed to be a pilot and exploratory in its nature, 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 conversation documentations and 9 comments. In the follow-on study 3 they created 21 documentations of experiences and 45 comments. In study 2, participants created 18 documentations of conversations and 14 comments (Table 1). These

usage figures were lower than initially expected, which be explained by the short timeframe of the studies, in which the time of adopting the app may have had an impact, but also by the fact that although a difficult conversation may bother people for several days, such situations do not happen daily and thus cannot results in large amount of documentations. 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. More important, they also told us that is was unclear to them at times what 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, which is express in a statement from a 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 in this study the head physician had been active commenting in the app, showing the value of comments to staff.

Type / Study	**Study 1**	**Study 2**	**Study 3**
Duration (days)	12[2]	33	49
Users	5	6	6 (7)
Documented conversations	7	18	21
Documented results	3	2	3
Comments (own/others)	9	14 (11/3)	45(32/13)

Table 1: Usage of the REFLECT App in the two studies.

4.2 Usage of the app beyond Content Creation

The usage statistics also reveal that there was more usage than the number given above suggest. Table 2 shows data from study 3, which demonstrates this most obviously: participants logged into the app 101 times (about 2 times per day for the whole duration of the study) and read documentations 146 times often (about 3 times per day on average, 7 times per documentation).

This shows that there was an interest in shared documents among the caregivers, but that they did not take the opportunity to comment on them. In addition, 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. In addition, we can see different ways of using the app: While e.g., user 6 had used most features equally, for users 2 and 3 we can see a preference in commenting (making them "commenters"), and users 4 and 5 created some documents but less comments ("documenters").

Action	**U1**	**U2**	**U3**	**U4**	**U5**	**U6**	**A**	**Sum**
Log In	17	21	8	5	16	32	2	101
View Doc	21	33	12	14	20	45	1	146
Comment	7	5	12	3	3	13	2	45
Create Doc	2	1	1	4	7	6	0	21

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

[2] Due to technical problems, data for earlier days was lost.

Qualitative feedback from users explains the figures in Table 2 partly: Some physicians ("documenters") reported that they had used the app to document issues in order to share relevant cases with their colleagues and to follow up on them later ("I documented what I thought was interesting for others"), as this was a missing opportunity in their usual work practice. Others ("commenters") stated that they wanted to use the app to communicate ("I commented where I thought it was necessary"). Asked about the impact of the app, physicians from study 1 reported that they had been more aware of the need for reflection, which 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.

A combined look at the data in tables 1 and 2 shows that the app was used to a different extent for different steps of collaborative reflection: While it was *used for documenting, reading and sharing conversations*, *reading or creating results and commenting was done less*. For the latter, our observations and interviews indicate that the participants created more results verbally, but did not add them to the app. The amount of logins and document views shows that this was not because of scarce app usage and lacking opportunities, but must have other reasons as described above.

4.3 Different degrees 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. An analysis of observations and interviews that because of that opportunities e.g. to document results were missed.

Type	Articulation
Documented Conversation	"[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."
Own Comment	"[Relative] conveys the feeling it is our fault. (…) Hears for the first time that [patient] is going to die"
Comment by others	"[From my experience] especially in the first talk it is important to take some time"
Result	"Problem: Conversation held alone. It should be known that a senior physician can be asked for support"

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

The example in Table 3 shows how the app was used during a (face-to-face) reflection meeting (observed in study 2) and how this led to the documentation of a result. In contrast, the example shown in Table 4 shows how participants made full use of the app. The differences in using the app for reflection support and the preference for using it for the initial parts of reflection activities were mainly caused by the preference of participants to clarify complex issues face to face rather than doing it asynchronously and using an app for it: In all studies participants reported that they preferred talking about issues directly with others.

Type	Articulation
Documented Conversation	„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.“
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 4: Example of an asynchronous reflection cycle conducted in the REFLECT app (study 1).

5 Discussion: Designing collaborative Reflection support that makes a difference

The results of the study show that the app had impacts on the participants, but that these impacts not always left traces in the app – in contrast, the app triggered personal communication, only a fraction of results were documented and discussions were (with the exception of study 3) held mainly face to face. This shows that we need to create *socio-technical reflection support* in which tools may enable individuals and group to reflect better. For this, we propose to design support for small groups and communities to account for a critical mass of users and prompting users to certain features of 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 possibility to document results provided by the app in the studies may also be a result of the groups chosen for the trials: In all studies, the participants knew each other, they worked together closely at the same physical location, and in both workplaces, there was a culture of talking about issues personally and frequently. A 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 attributed to the head physician being active in the app and creating comments: This motivated users to add comments and communicate with the head physician, whom they cannot get hold of to reflect together as easily as a colleague.

Usage may also have been affected by the imbalance in user activity. While some users being more active than others in communities is natural (Lave & Wenger, 1991), it might kill motivation in small groups of five participants: Active users will recognize over time that there are only a few others as active as they are, which will in turn decrease the value they perceive in using the app.

While this may change over time, it may foremost 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 may add more value by enabling discussions on experiences remotely. As enough users to create a critical mass may not always be available in organisations (for example in studies 1 and 3 the hospital ward employed a total of eight physicians) we propose to link reflection participants to others, who also have a professional interest to reflect on work, *beyond the boundaries of their departments or organizations*, forming *reflection communities*. Such communities would allow users to also share experiences and get feedback on them from users with similar work and outside their working group and to reflect together in a community of practice (Wenger, 1999). This may also make these tools attractive to more users in the organizations, as it shows how a reflection group can create a better understanding of one’s work and expertise for their job (Lave & Wenger, 1991) and help to create.

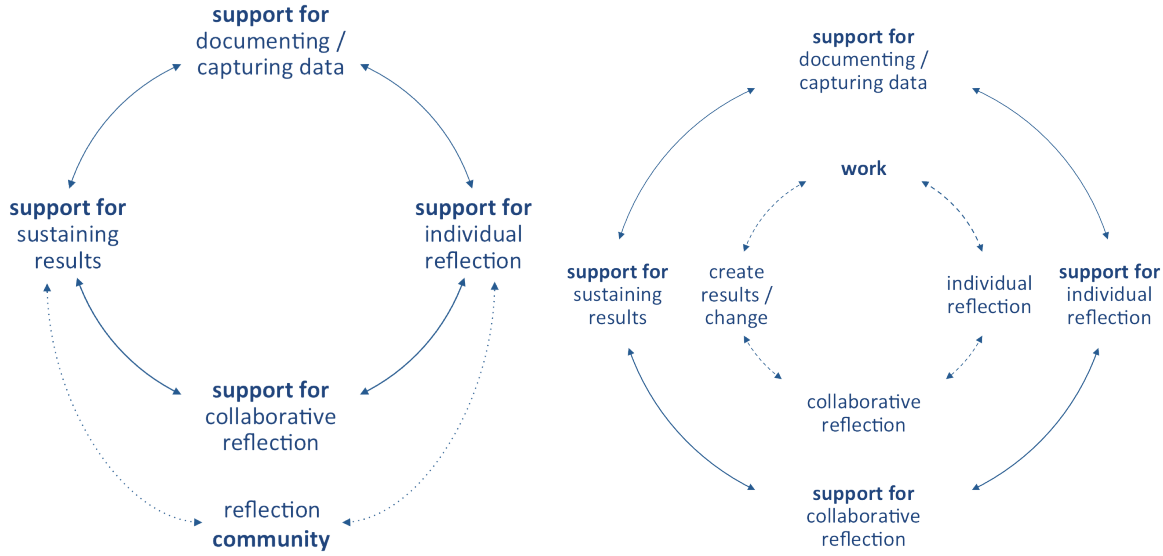

Figure 3: Model / cycle of collaborative reflection with (a) community support and (b) separation between social and tool-based cycles of collaborative reflection.

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

The studies show that the benefit of using tools for collaborative reflection and to follow up on content in tools may not be immediately obvious to workers, which may lead to tool usage being reduced to certain tasks. Lacking tool use is not necessarily a problem, as we observed a lot of reflection taking place in face-to-face reflection meetings as a result of using the app. However, it is obvious that *leaving comments*, *referring to others' comments in reflection* and to *having comments at hand when reflecting* enable sharing insights with a larger audience. Tools like the REFLECT App may support such situations if they are regularly used, as our examples indicate. To tap from this potential, people need to be constantly made aware of available tools and that these have a positive effect on learning and support of collaboration. As result, we developed a mechanism for REFLECT that prompts users to collaborative activities on three different levels (see Table 5):

Concerning the goal to *make people aware of the value that using reflection tools reflection may have for them,* the aim is to create awareness on what tools can do for users, making their value more evident. For example, people could be given an impulse to create a documentation of experiences regularly. Prompts should 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 get ideas what to write in a comment to express their reflections on experiences and may *point users to the value of commenting* and may also *help them to come up with ideas what to write*.

To *allow face-to-face collaborative reflection to leave traces in reflection tools* we must overcome situations in which people created ideas and results in face-to-face collaborative reflection but hardly captured insights from this reflection in the tool. For this, traditional means such as minutes or notes taken during meetings are not applicable, as there is no scribe available for reflection in the hallway and as minutes of staff meetings will not contain a full transcript of discussion contributions.

Combining these levels makes the potential of tools for reflection available in practice while leaving enough freedom for face-to-face reflection: The prompts may make people aware of certain options (e.g., sending them an email to ask whether they would like to document experience), but may also be

more strict (e.g., making reminders parts of agendas, enforcing answers to them or using dialogues with questions that need to be closed or answered to proceed).

Level of prompt	Examples
1: Prompting to use a reflection tool (more frequently)	Email or notifications on mobile devices for awareness of tool support, e.g. "Did you recently have a difficult conversation you want to document?"
2: Prompting for the use of features	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
3: Prompting to leave traces from face-to- face meetings	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.

Table 5: Prompts to facilitate collaborative reflection in tools.

As an initial step, we implemented the second level of prompts in the REFLECT App, which was equipped with a mechanism for prompting. Figure 4 shows an example of this mechanism, in which a prompt asked a user of the REFLECT App whether she has been in a similar situation and provides her with a text field to create a comment on what she did in this situation.

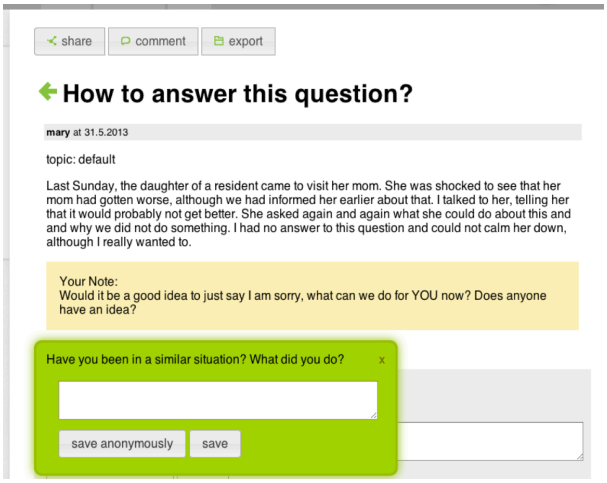

Figure 4: Prompting in the REFLECT app.

6 Conclusion: Designing collaborative reflection support

Our studies indicate that we need to understand collaborative reflection tools as socio-technical support. In order to make them work in existing work (and communication) structures, we not only need to integrate them smoothly into work procedures (as study 3 shows), but also to design them in a way that brings (existing) social interaction closer to tools and the other way round. The proposal of reflection communities and the three prompting levels exemplify this by scaling reflection to different user groups and processes of reflection (communities) as well as by prompting into the social space to use features and leave traces from reflection.

On a conceptual or design level, our work adds to the understanding of collaborative reflection design in that is does adds to existing work a level of co-design between the social and technology-supported levels of reflection. We differentiates between social (i.e. face-to-face, personal communication) aspects and processes of collaborative reflection, in which work leads to individual and collaborative reflection and finally enables the creation of change or results. In such processes collaborative

reflection generally works, but – as described above – may lack support and lead to lost potential of collaborative reflection. The technology-enhanced, tool-based reflection aspects offer support to overcome certain shortcomings of reflection in the social cycle.

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 by with tools, complementing the social cycle with tool support. These transitions also map to the prompting levels described in Table 5: For example, creating comments for individual and collaborative reflection needs prompting to use features (commenting) more often during the corresponding activities in the social cycle. The model can be used to analyse and design tool use for support of collaborative reflection.

There are certain limitations to our insights: While this paper presents an approach in supporting collaborative reflection systematically, it deals with only a few cases and small numbers of participants and therefore cannot provide scrutiny for or generalization of these design principles for collaborative reflection tools. Further work e.g. with the mechanism shown in will have to show whether flexible prompting can foster tool use as envisioned, and the effect of community support has to be investigated as well. The implementation shown in enables such testing and, at the time of writing this paper, is being tested in the organizations of studies 1-3 and additional workplaces

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