Collaborative Reflection at Work: Supporting Informal Learning at a Healthcare Workplace

ABSTRACT

Reflection is a common means to improve individual and collaborative work: Every day, people think back to past work and – oftentimes in a group – try to find out whether they can improve it or whether they can derive better practices from it. However, is neglected from the viewpoint of research and design. Consequently, there are hardly any insights on how collaborative reflection takes place in practice and how tools can support it. To shed light on these questions, this paper presents a case that has been analyzed in a hospital as part of a series of studies on collaborative reflection in practice. Focusing this case and backing it with the other studies, the paper presents peculiarities and needs of collaborative reflection in healthcare workplaces as well as a more general formalization of collaborative reflection characteristics. Based on these results, an application to support physicians in their reflection was prototyped and evaluated. The results presented primarily apply to healthcare workplaces, but also cover general findings for the support of collaborative reflection.

Categories and Subject Descriptors

H.5.3 [**Group and Organization Interfaces**]: Computer-supported cooperative work

General Terms

Design, Human Factors

Keywords

Reflection, collaboration, workplace, learning

1. INTRODUCTION

Reflection is a ubiquitous and frequent task performed explicitly and (most often) implicitly during and after everyday work: People think about whether they did a certain action right, whether their cooperation with others runs smoothly and how things can be improved. This process of going back to past experiences, reassessing them and deriving consequences for future behavior [2] is typical for most of nowadays' workers.

Reflection has been recognized earlier on as an integral task for (cooperative) work and learning [13,19]. This holds especially true for workplaces with a strong emotional influence on workers such as in healthcare, where emotional stress needs to be reflected in order to learn for the future and not affect a worker on the long run [8,22]. Accordingly, reflection has been found to be a well-established task among healthcare workers [23].

However, the ubiquity of reflection in daily work and life neither means that it is always applied successfully nor that it is supported sufficiently. One striking issue in reflection is that – without further support – reflection is mainly based in memories of past situations, which may have become hazy and, in terms of describing the situation reflected about, incomplete. This can then lead to wrong conclusions drawn from reflection. While this can be diminished by using existing documentation, such material is often not at hand or its content is not sufficient to support proper reflection. In addition, the majority of work on reflection support regards reflection as an individual and *cognitive* process (see section 2 for an elaboration on this). While this work led to valuable insights, it leaves out reflection happening in collaboration with others – e.g. meetings in which a team reflects on its practice or discussions in which workers mutually reflect on stressful situations. This cuts important and potentially fruitful occurrences of reflection from proper support.

As a result of the shortcomings addressed above, there is hardly any tool support for collaborative reflection. Such support needs to provide users with data complementing their memories of certain situations, help them structure this data and make sense of it for reflection, including both subjective perspectives and objective data on what has happened. With respect to *collaborative* reflection, it needs to support groups reflecting together to mutually make sense of their experiences and learn from each other. However, little is known about the process of collaborative reflection and how to support it with tools.

This paper reports on research done to investigate and support collaborative reflection. It presents a case study eliciting the characteristics and needs of collaborative reflection in practice and follow-up work in developing and evaluating a tool for its support. The paper mainly draws on work done in cooperation with a German hospital and is backed up by similar studies conducted in the same line of work[1]. The initial study in the hospital was conducted as an exploration of collaborative reflection in practice and its results have been checked against the other studies. The tool developed according to the resulting insights into collaborative reflection was evaluated formatively in workshops with physicians from the same hospital. This paper describes the whole cycle of exploring collaborative reflection, operationalizing results from this exploration as well as developing and evaluating a tool based on these results.

In the remainder of this paper, we will first discuss existing work on (collaborative) reflection, IT support for it and its specific characteristics and constraints at the healthcare workplace (section 2). After that, we describe our case study at the hospital and observations stemming from that (section 3), which – in accordance to results of the other studies done in parallel – will be analyzed in section 4. Based on the results of this analysis, which form an initial framework to support collaborative reflection, we describe the design and evaluation of a prototype to support reflection in healthcare contexts (section 5). The paper concludes with remarks on our work and plans for its continuation.

2. REFLECTION AT THE WORKPLACE

2.1 Characteristics of reflection

Reflection is a common activity at workplaces. It occurs frequently and more or less implicitly, as there is not always a conscious decision to reflect. It can be described as "those intellectual and

[1] This work is part oft he MIRROR project funded by the European Commission in FP 7. The MIRROR projects aims at supporting reflection in various settings, stages and levels. More information can be found at http://www.mirror-project.eu/.

affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciations" [2]. Reflection consists of three steps: going back to past experiences, re-evaluating this experience and deriving insights for future behavior from this reassessment (Figure 1, [2]).

As Figure 1 shows, experience consists of past behavior, ideas and feelings towards past events. Reflection then means to mentally return to these elements of experience in order to re-evaluate them. Outcomes of this process include new perspectives on own experience, changes in behavior or at least knowledge and readiness for changing behavior. The model shown in Figure 1 also indicates that reflection and going back to experiences not necessarily lead to outcomes in a linear fashion, making reflection a frequent and ongoing process with loopbacks. With respect to reflection support it has to be emphasized that reflection is not limited to resolving problematic situations, but can (and should) also be applied to identify and sustain good practice. Reflection in this sense means learning from experiences and has been identified as a decisive mechanism in modern workplaces [1,2,13]. Schön [19] added that there is a differentiation between reflection "in action", which is happening during the conduction of an action, and reflection "on action", which depicts reflection happening after the action is finished. Although Schön originally focused on individual reflection in this distinction, it also applies to collaborative reflection. It is obvious that both modes pose different needs and constraints for support.

Reflection needs to be differentiated from other forms of thinking about past or current issues. What differentiates it, for example from rumination is that reflection needs to have an outcome, meaning that at least insights on past behavior are derived from a reflection process. Reflection is also close to problem-based learning [19] – learning from problem solving requires reflection on past problem solving experiences, particularly in those cases where problems may be solved by reflecting on the occurrences in practice. However, it can be differentiated from problem solving by the premise that reflection is based on past behavior. The triad of past experience, reassessment and learning for the future thus makes reflection a unique process of learning and knowledge construction.

2.2 Collaborative reflection

The majority of research on reflection is done with a focus on individual reflection. Therefore, most models of reflection have a strong individual focus (e.g. [2,13,19]). Collaborative reflection, in contrast, is far less covered by current literature [12].

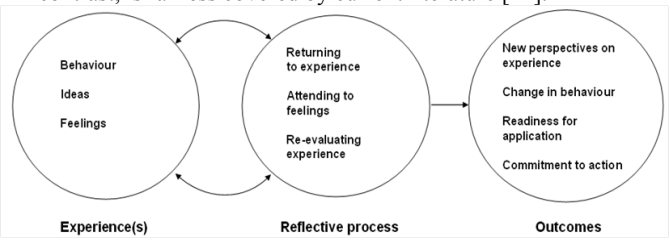

Figure 1. Phases of reflection, based on [2].

Collaborative reflection can be described as a social process in which "people engage in finding common meanings in making sense of the collective work they do" ([10]) or as "tool(s) for explicating and making implicit knowledge embedded in contexts" ([11]). The main difference between collaborative and individual processes of reflection is the focus of reflection activities: for individual reflection, this focus is set to individual cognition, whereas research on collaborative reflection needs to focus on communication and coordination: engagement in dialogical interaction as well as sharing and processing of mutual experiences have to be seen as core elements of collaborative reflection [4,20].

As described above, for collaborative reflection people must share their experiences and communicate about them, ideally leading to shared sense making [3,8,20]. Collaborative reflection then occurs if an individual links her knowledge to the experience of others [3] or when a group combines experiences of its members to reflect on them collaboratively [10]. Thus, collaborative reflection may be about individual *or* collaborative work and requires support for the communicative interaction and experience of people reflecting together. Compared to individual reflection, collaborative reflection has the advantage to learn from each other and to craft new knowledge from shared experiences. The disadvantage, in turn, is that this process is more complex and needs structured communication and exchange.

Existing work on collaborative reflection is often restricted to specific and static situations such as debriefing sessions and project review meetings [2] or regards reflection mainly as an activity triggered by an individual seeking help in her individual reflection [25]. Therefore, most insights either on processes of reflection as described above or on tool support (see section 2.3) deal with such situations. There are contributions emphasizing that collaborative reflection also happens in informal, more dynamic situations [3,4], but little is known on collaborative reflection support in such situations. Therefore, further research on characteristics of collaborative reflection in practice is needed.

However, it is difficult to determine whether or not collaborative reflection occurs: not each discursive interaction about past events can be considered as collaborative reflection. A key to recognizing it can be found in the work of van Woerkom and Croon [24], who in addition to the general ingredients of (collaborative) reflection describe indicators for reflection such as "critical opinion sharing" during discourse, "challenging groupthink" as opposed to stick to norms, "asking for feedback" on own actions and "experimenting with alternatives" [24]. In the work described here, this set of indicators is used for identifying collaborative reflection.

2.3 IT support for reflection

Returning to own experiences is central to reflection, but human memory is limited: memories fade and thus, returning to past experiences properly is hard. Therefore, reflection can be supported with different data describing past experiences, ranging from and to (cf. [12]). While this data may be captured and shared among collaborators with generic tools from other contexts such as databases, notebooks and others, there are only little insights on tools specifically supporting collaborative reflection.

Among the scarce literature on reflection support, the usage of personal journals for individual reflection is mentioned often (e.g. [14]). In such journals, people can note experiences as in diaries or collect other artifacts such as pictures. Later, they can return to this data for reflection. Other authors propose digital portfolios for learners, including learning material and personal notes to reflect about e.g. learning processes ([20]). While these tools can be beneficial when returning to the data contained in them, they serve a generic reflection purpose and need the user to write down all experiences that could possibly be valuable for later reflection.

Among tools for more special purpose reflection support, the Microsoft SenseCam, which takes pictures when the scenery in front of it changes, has been reported to support reflection well, even in reflection groups [6,7]. Individuals and groups use the

resulting pictures to recreate the events in which they wore the SenseCam and to point to certain experiences during these events. To the knowledge of the authors, besides this and very few other special purpose tools, there is no proper tool support for collaborative reflection available.

2.4 Reflection at the healthcare workplace

In healthcare workplaces and especially in hospital care, reflection has been found to be a common and well-established practice [8,16,23]. The majority of existing literature points to applications of reflection in two areas: medical issues such as diagnosis and practice as part of daily work [16,23] and training for work [8,16].

Concerning medical aspects, literature assumes that reflection is mostly triggered by medical problems such as difficult diagnoses, including varying personal inclinations and preferences on reflection personal practice [16]. In addition, it was found that for physicians the tendency to reflect on their daily work decreases in parallel with an increase of their experiences and years of practice [15]. Concerning support for reflective practice, literature mainly assumes guidance and supervision to be triggers of reflection in healthcare. Typical applications of reflection involve evaluating previous assumptions on a patient's health development, comparing difficult situations with past experiences and challenging own diagnoses [15]. While this is primarily an individual practice, it is also common in healthcare environments that staff (especially physicians) holds meetings and discusses patients and their states.

In training, reflection is considered to be an important practice of nurses and caretakers both in training before and on the job, as these groups need to develop a habit of critical thinking and to gradually adopt good practice by learning from others [8,9,23]. In such situations, using a journal to write down experiences and learn from them for later practice is common, although it has been shown to reduce face to face communication and reflection [8].

Research in the reflection of nurses also points to the *collaborative* dimension of reflection in healthcare workplaces. Collaborative reflection has been observed in nurses developing ideas and solutions for care problems together [9] and to improve their behavior in certain situations [23] – both situations transcend medical or training areas and reflect the need to collaborative create better practice at such workplaces. This indicates that besides medical skills and training issues, dealing with emotions and work organization on a social level are also topics of reflection to be regarded in healthcare work. However, besides describing the conduction of reflection in collaborative situations such as supervision and meetings, corresponding contributions do not provide details on reflection processes or needs in such cases.

3. COLLABORATIVE REFLECTION IN HEALTHCARE: A CASE STUDY

There are hardly any insights into collaborative processes of reflection. To gain such insights for the development of proper tool support and as part of a series of workplace studies on collaborative reflection[2], we conducted an exploratory study at a German hospital ward dealing with stroke patients.

3.1 Methodology

The study was conducted as an exploration of collaborative reflection practice and needs – the state of the art in research on collaborative reflection and tool support for it did not allow us to build assumptions prior to this study. Therefore, we conducted explorative interviews and observations in the stroke ward of the hospital, which included physicians and nurses. In total, we observed two workers and conducted interviews with four people, which we consider sufficient for an exploration.

The primary means of the study can be seen in the work observations, during which two researchers followed a nurse and a physician during their whole shift for two days, noting down all situations of their work with a special focus on the occurrences of reflection. The purpose of these observations was to understand the work done in healthcare environments as a basis for tool development, including habits of communication and cooperation, constraints imposed by the workplace and actual practice of reflection as opposed to literature. For this, the observers oriented their notes towards an observation scheme containing aspects of reflection such as interaction with colleagues (participants, place, time etc.), occurrences of reflection (participants, topic, data used etc.) and technology used (purpose, relation to work etc.). The resulting notes were transcribed and coded with the categories from the observation scheme.

Interviews were conducted with the observed workers and additional staff of the ward with the main purpose to clarify rationales, needs and wishes of healthcare staff with respect to (collaborative) reflection. The interviews lasted 45 to 60 minutes each and contained questions about the interviewees' workplace, its special characteristics, aspects of learning and motivation in daily work, communication and collaboration during the day as well as existing and envisioned practice of individual and collaborative reflection – some of these were omitted for the persons who had already been observed for two days. Sample questions from the inventory are *"When and how do you communicate with others about your work?"* or *"Please give an example of when a colleague talked to you about his work-related experience"*. Interviews lasted between 45 and 90 minutes. Each interview was audiotaped and later transcribed literally. For example, *asking for feedback* is an indicator of reflection occurring when one person asks others to give feedback on her work from the others' experience. The interviews were audiotaped, transcribed an coded in a process aligned to Grounded Theory coding [21], which was complemented by preset codes containing the indicators for collaborative reflection (cf. [24]) described in section 2.2. This approach was taken to be open for the identification of characteristics and needs of collaborative reflection on one hand and to be sure to detect situations of collaborative reflection completely and correctly on the other hand. For example, we coded a situation in which nurses asked each other to assess and validate the treatment given to a patient during the day to be collaborative reflection as it is an example of asking for feedback and contains all phases of reflection described above (see sections 2.1 and 2.2).

In the analysis, interviews and observation complemented each other: while in interviews outcomes can be based on particular episodes and thus not represent daily work, observations allow for insights into daily routines. Likewise, interviewees might not sufficiently describe their practice of reflection, as it often happens implicitly. On the other hand, observations cannot result in an overview of all aspects relevant for collaborative reflection. Therefore, for the staff both observed and interviewed, we intertwined the resulting material in our analysis.

3.2 Background: Work in the hospital ward

The target group we interviewed and observed consisted of physicians and nurses working in the stroke ward of a German hospital.

[2] Additional studies were conducted at e.g. British care homes and, to broaden the view on collaborative reflection, at a German IT consulting company.

Before we present observations on reflection stemming from this study, we describe our observations on the work on this ward to give a context of the study.

Staff on the stroke ward is highly trained. Nurses, for example, need special skills to be allowed to work with acute stroke patients. Their primary motivation to work on the ward could be found in the desire to help people. Providing good care, saving lives and improving the quality of patients' lives are examples for this we found in the material. Work is organized in shifts for both nurses and physicians: physicians work in a two shift system covering days and nights, nurses work in shifts for the morning, the afternoon and the night. Between shifts, handovers are done within and between these two professional groups. Work at the ward is highly depended on communication and cooperation: while physicians are responsible for monitoring patients, diagnoses being carried out and decisions about medical treatment, nurses do the daily tasks of assistance, care, washing and drug application. Nurses therefore do most of their work in the patients' rooms and help each other in difficult or more exhausting tasks. Physicians partly spend their day in patients' rooms, e.g. during the ward round and daily check ups, in their offices, doing documentation and research as well as around the ward, e.g. talking to relatives of their patients.

Work in the ward is constrained by time pressure. Physicians have a highly structured day consisting of ward rounds, daily meetings with colleagues to discuss patients' cases, examinations, documentation and emergencies. Nurses are taking care of or two patient rooms per day, which includes giving the treatment and care to the patients that has been prescribed by the physicians. In parallel, they need to do the documentation of this treatment as well as patient's physiological data such as blood pressure, medications given and incidents happening during the day. As a symptom of this time pressure, we were told that staff often completes mandatory documentation tasks after their shift has finished as this guarantees that the patients are being cared for.

In order to coordinate work under these circumstances, physicians and nurses use a chart placed at the bed of each patient, which they call "the curve" and in which each change in the status of patients as well as changes in treatment or examinations are written down in a protocol and serve as a basis of the work of nurses. In addition, some documentation such as patients leaving or joining the station is done in a hospital information system.

In addition, the work of physicians and nurses is emotionally stressful. Nurses need to work closely with patients who may not be able to articulate what they need or getting worse every day – the opposite way around, we could observe collective happiness in cases, in which patients got better after a stroke. Physicians need to make decisions, which might affect patients' lives or at least their quality of life. Moreover, they need to talk to relatives of patients, which oftentimes include telling bad news. Therefore, supervision is considered to be an important mechanism by both nurses and physicians and the solidarity among all members of the ward is very high – reportedly, mutual help in stressful and sad situations is a matter of course and a necessity in the ward.

This solidarity is also mirrored in the regular meetings of ward staff. Besides the daily meetings and handovers, once in a month there is a meeting for all staff members, including office, nursing and medical staff as well as therapists. We even observed staff from the night shift joining this meeting, although they had finished their shift a couple of hours ago. The meeting is announced with a bulletin in the break room, and everybody can note down topics they want to discuss on this bulletin. As described below, this meeting also gives rooms for reflection on comprehensive topics in the ward. We observed the discussion culture to be very open, as everybody is taken for serious and may pose a problem or comment on certain issues.

The usage of information technology differs much between nurses and physicians. While nurses have access to shared computers, they may not access the Internet but only the hospital information system and a digital quality management handbook on the intranet. Physicians, in contrast, can use computers connected to the Internet in their offices for research purposes.

3.3 Reflection practice in the hospital

Our analysis of the hospital study also contains detailed insights into the structures and constraints influencing collaborative reflection at this workplace. This contains different reflection settings, barriers and opportunities for reflection and insights into the collaboration of reflection participants.

One insight in reflection practice is that reflection happens both in (scheduled) meetings and emerges from interaction during the day. As for **reflection in meetings**, we found the daily meetings of physicians, the handovers between shifts and the ward meetings to be most important. In handover sessions, which are usually run by one of the nurses summarizing the shift for her colleagues and informing them about the most relevant issues to be taken care of, staff often collaboratively reflect for short periods of time by asking e.g. each other for feedback on care given to a patient during the day or discussing interaction with certain patients based on experiences with the patients. In the daily meeting of physicians, reflection may occur due to one of the physicians presenting a case and other stepping in on aspects such as diagnosis or treatment based on their experiences with similar cases. In meetings with the whole ward, which are held less frequently, we observed reflection to be more structured, but also more difficult with respect to creating a shared context. Such meetings, as explained above, are prepared with a public agenda, which all members of staff may edit. As a typical example, we observed a meeting in which the head nurse proposed to change the way breaks are taken in the morning. As some meeting participants did not understand why this was proposed, she gave some examples in which a shift of break times caused difficulties in the operation of the ward by e.g. interfering with the daily ward round. After that, others reported on their experiences with this issue and the participants decided on changes in the break times. In another example, the head nurse complained that physicians to often enter rooms ignoring the patients. She gave examples and explained that this often results in patients asking the nurses afterwards about what happened and if there is something new. Some physicians explained that they could not always start a conversation with the patient because there this would take too much time. After a discussion they agreed that both groups should make it more clear to the patients in which situations (e.g. ward rounds) they can ask questions and when not. They also agreed that during handover meetings between physicians that take place at the bedside they will do short conversations with patients, as these are the first contacts between them at the day.

Concerning **reflection outside meetings**, these processes are more informal and significantly shorter than reflection in meetings. Although these reflection situations are oftentimes implicit and embedded into communication, which makes them harder to recognize both for interviewees and observers, our analysis shows that there are plenty of such situations and that they have more relevance for the support of collaborative reflection than literature represents. Typical examples of such occasions are breaks, in

which nurses and physicians sit together, working together on the same task and reflecting on it, and spontaneous encounters on the hallway, during which staff briefly reflects on (mostly) small issue. Such reflection occurs when staff talks about problems in daily work, such as supply with equipment, or as a result of implicit routines, such as asking each other for help or reassurance with specific issues during the day. For example, we observed nurses reflecting frequently on why they could not find medical gloves and then continuing with their work. Likewise, collaborative reflection is often related to special situations like incidents happening or emotionally relevant experiences.

Looking at **constraints and challenges** in supporting collaborative reflection, we observed that a lot of small outcomes from spontaneous reflection were not systematically sustained. Taking the example of break times described in section 3.2, we observed nurses reflect a couple of times during one day on how to deal with this issue for a short time e.g. on the hallway and then turn to work with patients. However, follow up actions were never planned in such situations and the nurses did not take notes. This shows that outcomes and topics of spontaneous reflection are less persistent. This may then result in situations such as described for the meeting above (section 3.2), in which some nurses do not remember problems discussed or are no more consciously aware of them. In addition, we found that collaborative reflection is already very prominent among staff if topics concern interaction with patients and incidents of them. It occurred mostly when an individual lacked understanding of a patient's situation or treatment and asked others to reflect on this situation together.

Moreover, we also found that in terms of **documenting experiences**, physicians and nurses are only likely to make notes if they see and immediate or at least mid-term personal benefit or if it is inevitable to e.g. legal restrictions. This is not a new insight, as personal benefit is a critical preconditions for knowledge exchange in general [5]. However, in healthcare settings documentation is even more critical in terms of time and priorities: given the highly packed work day of staff, they are cautious to take unnecessary efforts, which may then result in less time for patients. Therefore, solutions supporting reflection at such workplaces need to show the potential benefit. Nevertheless, we found that *existing* documentation was often used as a trigger or guide for reflection. During the whole day, documents like the abovementioned curve at patients' beds guided the reflection of nurses and physicians. For example, we saw many times two or more nurses gathering around this documentation and reflecting on treatment given to a resident. This suggests that documented experiences can be valuable guides for collaborative reflection in healthcare.

3.4 Discussion: New insights into reflection at healthcare workplaces

From our study one can see that staff at healthcare workplaces are faced with scarcity of time and emotionally demanding, responsible tasks. In addition, it can be seen that the teamwork aspect is very present in such workplaces, as good work depends on cooperation and coordination among colleagues: nurses and physicians formed a collective, helping each other in stressful situations. In addition, our studies underpin the insights from literature that reflection is a common practice at healthcare workplaces.

There are two novel foci of support to take away from our studies with respect to reflection specific for healthcare workplaces. First, reflection in healthcare is not limited to medical and training aspects, but is also common on team coordination, communication and similar aspects. Therefore, in contrast to most literature (see section 2.4), a focus of reflection support should also be set to these issues, as these are crucial for good care and because they are typically reflected collaboratively. The topic of communication with patients described above is a typical example for this, as it is a matter of ward organization but directly affects the quality of care. Second, tools to support the documentation of experiences and reflection based on this need to take into account the need for flexibility in space and time. In both studies, we found that staff did not have much time to explicitly step back and reflect – in contrast, we observed nurses and physicians to reflect often during and between tasks. The challenge thus is to fit support into these constraints and to make results from this reflection sustainable.

Our studies indicate that collaborative reflection is both underdeveloped and needed in such workplaces. Means to deal with e.g. stressful situations such as supervision are too infrequent. Thus, we observed many situations in which colleagues started to reflect on such situations – one example is nurses asking each other for reassurance on treatment given to a patient. In addition, we noticed situations in which the opportunity to reflect in a task would have been needed but was not there, e.g. when physicians felt bad about talking to relatives and giving them bad news.

4. ANALYSIS: MODES, TOPICS AND THE PROCESS OF COLLABORATIVE REFLECTION

Analyzing the observations from the study described above and combining them with insights from other studies run in parallel allows for an operationalization of collaborative reflection (see [17,18] for a more details of the analysis of all studies). This includes modes and topics of collaborative reflection, the relation between topic contextualization and aggregation as well as process characteristics of collaborative reflection. In what follows, we will describe the resulting constructs with a focus on their occurrence in healthcare workplaces like the hospital ward.

4.1 Context: Modes of reflection

From the healthcare study and the additional studies, it is obvious that there are different settings of collaborative reflection and necessary documentation of experiences to be supported: Sometimes, reflection happens in a **planned** meeting, whereas in other occasions it is **spontaneous**. In addition, it may happen **during** the task reflected on or **after** it – this is closely related to Schön's distinction between reflection in and on action (section 2.1). Based on this distinction, we developed a two-dimensional scheme describing what we call **modes of reflection** along an axis between planned and spontaneous reflection and another axis representing reflection on past work events and reflection occurring during work.

Occurrence / Relation to reflected work	**planned**	**spontaneous**
Reflection on past work events, "on action"	Scheduled meetings in which reflection is part of the agenda	Breaks, talks on the hallway, before / after work
Reflection on current task, "in action"	Daily handover sessions, meeting of physicians	Reflection on a patient while caring for her

Table 1: Occurrences of reflection (planned, spontaneous) and relation to work reflected about (on action, in action [19]) with examples from the healthcare study.

Table 1 shows the resulting matrix and examples for **reflection sessions** from the healthcare study. Looking at the examples shown in Table 1, it is obvious that these modes need to be supported in different ways. For example, reflection in scheduled meetings can be prepared by an **agenda** and may benefit from e.g. **facilitation**, whereas spontaneous reflection needs to be supported without both of these aids. In addition, both spontaneous reflection and reflection on action restrict the **time** for documenting experiences, getting back to existing documentation and sustaining outcomes of reflection. Our observation of staff making mandatory documentation in their free time shows that support for the non-mandatory task of documenting experience needs to be very flexible with respect to time. Moreover, all modes have a different timeframe for **following up** on earlier and planning later reflection: In meetings this may be done systematically by minutes, but in other modes existing topics have to be at hand spontaneously. Thus, maintaining a shared context between people and making them aware of existing content is important in all cases.

Looking at these differences, it is necessary to see that although done in different modes, different sessions of collaborative reflection might be about the **same topic** or at least share a **common context**. In this constellation, results from e.g. a reflection session during a break might be needed or at least be interesting for a regular meeting but forgotten due lacking documentation. Support for collaborative reflection therefore also needs to provide means for transitions between outcomes stemming from different modes.

4.2 Topics: Contextualization and aggregation

Besides different modes of collaborative reflection, the topical level – whether a concrete situation or a more abstract problem is discussed – is important to be kept in mind for reflection support. The description of collaborative reflection practice in section 3.3 already indicates corresponding problems of starting and successfully practicing collaborative reflection in different situations and for different topics: For example, when nurses reflect on patients or interaction with them in handovers, they do not have much time and mostly stay on an **instance** (i.e. an **episode** happened during the day) or **case** (i.e. a patient) level, but only rarely relate episodes or cases to more comprehensive topics. Thus, problems are discussed redundantly and existing resolutions are not applied. The example of nurses discussing about medical gloves underpins this, as we observed it to happen frequently on the hallway but, according to our interviewees, it had never been discussed in a meeting. The other way around, reflection in meetings tends to be about more **comprehensive** topics (i.e. organizational issues) that can be announced on an agenda. This may lead to situations in which participants lack the context of such a topic. Like the examples of changes in the break structure and of communicating with patients show, this context often has to be reconstructed by communicating episodes in which the problem have occurred.

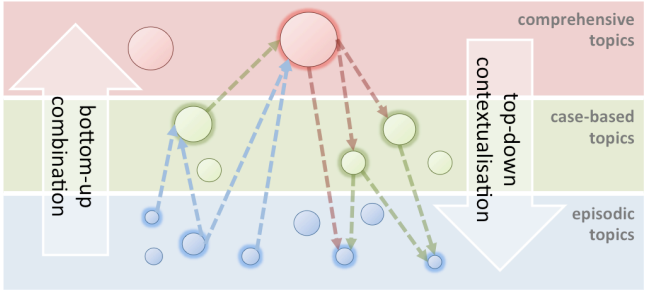

Figure 2: Topical levels in collaborative reflection.

Figure 2 described the relations between the levels of episodes, cases and comprehensive topics in collaborative reflection and the bottom-up and top-down needs described above. In the healthcare study (as well as in other parallel studies) we found that collaborative reflection in practice oftentimes is made up by many of these bottom-up and top-down cycles. This can be seen in the example of medical gloves and break times. Therefore, similar to the claim made in section 4.1, collaborative reflection support must relate these topical levels to each other, complementing comprehensive topics with episodes and cases and enabling workers to derive comprehensive topics from episodes and cases.

4.3 Process: A blueprint for collaborative reflection support

As another result, our observations show that there are five ingredients of collaborative reflection support. First, there is need to support the **documentation** of experiences and the **capturing of data** contextualizing experiences in order to form a thorough base for returning to experiences. Second, workers need to **individually** reflect on experiences in order to understand them better and to develop ideas for resolutions. It should be noted that these phases might happen in parallel as the documentation of experience may trigger individual reflection of it. Third, **collaborative reflection** takes place, which includes sharing experiences, communicating about them and negotiating resolutions. After that, **sustaining outcomes** is done to not let results go but document them properly. These phases are connected by and make use of **articulation**, which can serve different purposes such as explicating and explaining experiences or writing down outcomes. **Figure** 3 shows this process, which we derived as a blueprint for implementing tool support for collaborative reflection.

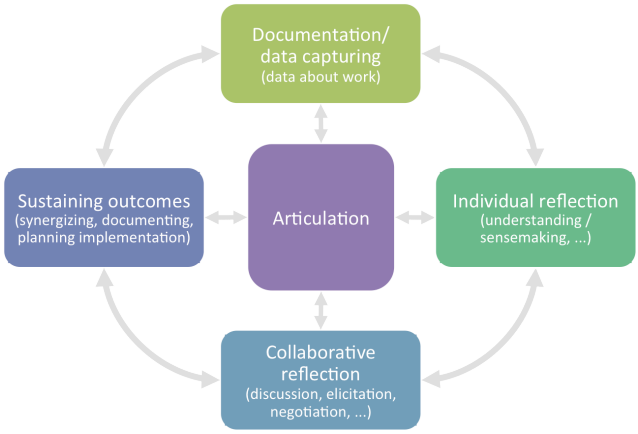

Figure 3: A process blueprint for collaborative reflection support.

This process can be illustrated by the example of physicians' communication with patients. Nurses had documented this issue for the head nurse, who had then started to reflect on her experiences with this issue. Then, she had prepared the topic for reflection in the ward meeting and nurses and physicians present in the meeting reflected on it collaboratively. After that, they agreed on outcomes and the head nurse wrote down their resolution.

The process shown in **Figure** 3 is not meant to prescribe a **linear sequence** of four steps for collaborative reflection, but explicitly allows going back to other steps. Examples such as the break time discussion at the ward, in which staff went back to individual reflection of episodes, shows that this is necessary. Likewise, the blueprint also allows **loops** within single steps like in the example of short-term, iterative collaborative reflection on the hallway.

However, it states that tools for collaborative reflection support need to bear in mind that during, before and after reflection there is a need for articulation, that individual reflection needs to be part of collaborative reflection and that tools need to support people in sustaining outcomes. However, steps of the process may also be left out if e.g. collaborative reflection on a new topic emerges spontaneously from a talk between workers.

5. SUPPORTING COLLABORATIVE REFLECTION

Based on the insights on collaborative reflection in general and for healthcare workplaces in particular, we developed an application for its support. It is designed to be used for the reflection of different topics. For first field tests, we tailored it to support the collaborative reflection of physicians' talks to patient relatives, which are particularly stressful for many physicians (cf. section 3). In addition, its concept was also tested for the collaborative reflection of nursing work by using a paper prototype.

5.1 Pre-Testing the Process Blueprint

Before we implemented the App, we conducted a workshop to pre-test the process described in 4.3, which was meant as a blueprint for the App. For this workshop, we gathered five employees of the ward (four nurses and a physician). In the workshop, we asked them to reflect on scenes taken from their daily work such as a patient complaining and a patient missing her valuables. These scenes were illustrated by a picture (see **Figure** 4). For their reflection, we asked the participants to follow a scripted process, which asked them to first **write down** similar scenes they had experienced (documentation, see section 4.3) on paper cards and **individually reflect** on them. After that, they were asked to share their experiences by pinning the cards to a board (**Figure** 4) and explain them to the others. In a third step, they were asked to **discuss** different experiences of a respective scene (collaborative reflection) and try to come up with a **resolution** of the scene (sustaining outcomes). As can be seen, this script follows the process blueprint of collaborative reflection support described in section 4.3, with articulation present e.g. in explaining experiences to others and discuss them. The goals of this pre-test were to find out whether the process was applicable in practice and whether collaborative reflection provides a benefit compared to individual reflection of work

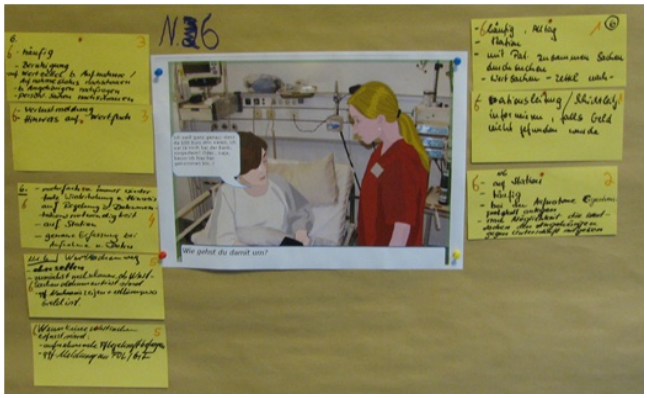

Figure 4: Results of the pre-Test of the process blueprint for collaborative reflection support.

The workshop produced rich results and, in addition, the participants reported that had achieved new insights on their work. In particular, the participants wrote 41 paper cards, among which we found 13 stories of experiences and 17 resolutions for problems identified in the scenes. This indicates that documenting experiences is a proper means to form a base for reflection – it took only a short time and was expressive enough to relate later reflection to. The number of resolutions suggests that the process we scripted for the participants in combination with the paper prototype was adequate and helpful to derive insights on how to change future behavior. In addition, for some resolutions the participants agreed on further actions such as proposing a different way of handling patients' valuables to the quality management standard of the hospital.

What is also interesting about the contributions of the participants is that they referred to each other in the way we had planned: They documented their experiences regarding the respective scene and added personal reflection results such as potential resolutions to it. They easily articulated their experiences to explain them to others and derived many insights from the different experiences discussed. This suggests that our process can be used as a blueprint to create tools to support collaborative reflection. In an informal talk after the workshop, three participants explicitly reported that they had reached a level of certainty and agreement among colleagues that would not have been possible without the collaborative reflection of their different experiences.

5.2 The TalkReflection App: A prototypical tool for reflection support of relative talks

Based on the evaluation of the paper prototype described above, we implemented a mobile application to support collaborative reflection. As a pilot area for evaluation of this application, we chose physicians' talks to relatives, which is an area in which physicians are usually not trained during their education. Talking to relatives is a frequent and very important task for physicians, as on the one hand, physicians are obliged to inform and emotionally assist relatives, and on the other hand, they need information from relatives to better judge the case of the patient.

As described above, we observed that physicians tended to be unsure about this task, as they perceive it as stressful, and even sometimes tried to avoid it (see section 3). In addition, the physicians told us that they were interested in improving their skills for this task and they agreed to support each other in this process. As they told us, there is a relation between how good one manages to talk to relatives and whether relatives complain about the treatment of patients – better talks apparently lower the complaint rate. The decision for this topic of reflection was made because supporting relative talks was found to be more pressuring than other tasks such as supporting the reflection of nursing work as described in the paper prototype evaluation. However, as can be seen from the description below, the prototype can also be used for this task with minor changes.

The TalkReflection-App is aligned to the process of collaborative reflection presented in 4.3 and in terms of its concept, it can be considered as an extension of the paper prototype described above. Aiming at supporting physicians in the articulation and collaborative reflection of relative talks, it consists of four basic elements representing the phases of the collaborative reflection process described in section 4.3: a form for **adding documentation** (Figure 5), a private space for **individual reflection** (Figure 6), group spaces for **collaborative reflection** and a result sheet to **sustain outcomes** of the reflection process (Figure 7). It also contains many opportunities for articulation such as the self-assessments for documented cases (see Figure 5 and below) or functionality to comment on own and shared documented cases (e.g. Figure 6, number 4). To cope with the constraints on time and space in the hospital, the app was designed to run on tablet devices in the first place, but also runs on PCs as a backup.

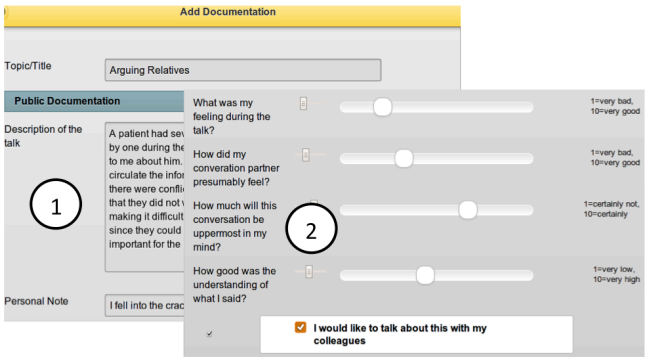

Figure 5: Documentation interface for documenting relative talks (left) and self-assessments (right).

The **documentation** interface (Figure 5, number 1) offers support to document cases for later reflection. This documentation is already part of daily work in order to inform other physicians and nurses about which information have already been given to patients and relatives. In addition, this is done to have a proof that relatives have been informed sufficiently in case a physician or the hospital are blamed later on e.g. if something went wrong. The TalkReflection-App supports the capturing this information (see Figure 5, number 1). In addition, the physicians asked for means to leave **(self-) assessments** with their documentation in order to better understand them later on. Therefore, we developed questions together with the physicians (e.g. "How did my conversation partner presumably feel") and integrated them into the documentation interface: Answers to the respective questions can be given on a scale (Figure 5, number 2). These self-assessments are a good example of how **articulation** can support the documentation needed for later reflection.

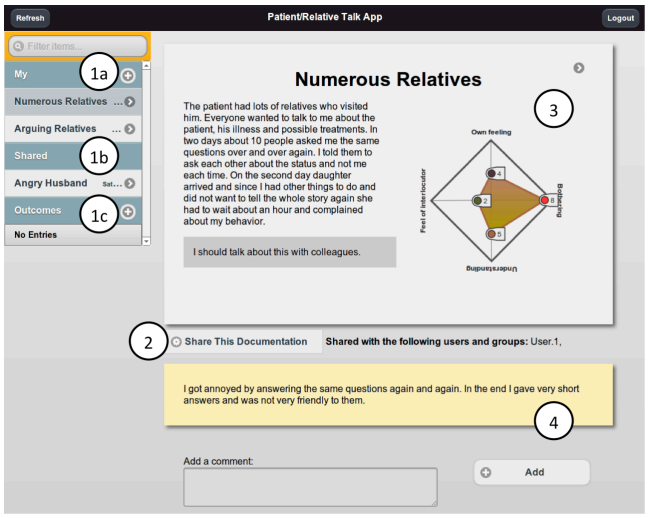

Figure 6: Individual and collaborative reflection spaces: Each documentation can be viewed, shared and discussed. Assessments displayed in spider graphs for a quick overview.

The main part of the application allows for **individual and collaborative reflection** (Figure 6). In individual (Figure 6, 1a) and collaborative (1b) workspaces, physicians can browse and read their own as well as shared documentation of talks with relatives. After a user has documented experiences from a talk as described above, it is shown in her personal workspace (Figure 6, number 3), including a graphic showing the self-assessment belonging to the documentation. During her individual reflection, the user may then add comments e.g. to articulate insights on the case (Figure 6, number 4). After that, she can share the case with others through a simple interface (number 2). Shared documentation can then be discussed asynchronously by using comments (users can comment on shared material) or, whenever there is time, the app can be used synchronously to support co-located collaborative reflection sessions (see Table 1). Figure 6 shows an example of a typical user entry[3], in which a physician described experiences from difficult talk with relatives and comments on it, discussing her experiences during the talk. Sharing this set of information on experiences can then help others to better understand the situation and makes it available for collaborative reflection.

In a third view, which can be accessed from the main view (Figure 6, 1c), users can review which documentations they have read and discussed during a reflection session in order to sustain results they have achieved (Figure 7, number 1). They may then select which those documentation belonging to a result and write down the result (Figure 7, number 2 and 3). These outcomes are collected in the application and can also be accessed by colleagues, making them available as good practices for dealing with difficult situations. Figure 7 shows a sample outcome called "Coordination of relatives" (bottom), which is related to two cases (the two lower case in Figure 7, number 1 are checked to indicate their relation to the outcome documented below).

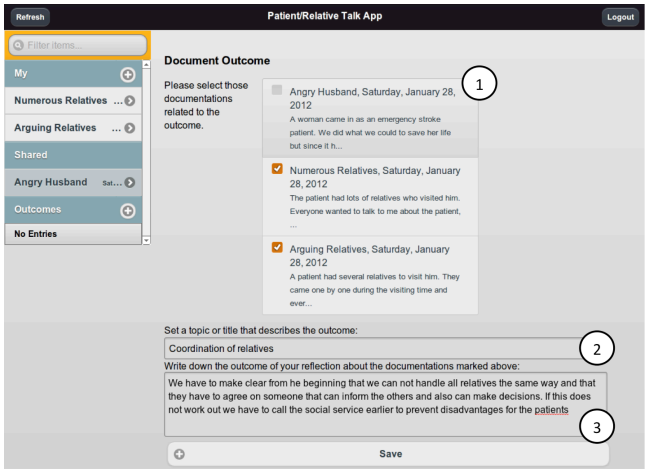

Figure 7: Outcomes of collaborative reflection sessions can be saved and related to cases.

As can be seen, the app covers all steps of the process blueprint presented in section 4.3. More than that, it **integrates these steps into the daily work of physicians**: Considering the time and space constraints imposed by working on a hospital ward, its implementation for mobile tablet devices allows physicians to document relative talks everywhere. In addition, the app can in principle be used in **all different modes of collaborative reflection** described in section 4.1. Especially **spontaneous reflection** and **reflection during work** can be supported well, as physicians can take the tablet devices the app is built for with them and use them spontaneously for documentation or referring to data during the day (see Figure 8). **Scheduled meetings** can also be supported: physicians can prepare the meeting by documenting and choosing case and use the app during a meeting to share cases and support their discussion with this data.

[3] Due to the confidentiality of real documentation, all entries in the figures were created by the authors but resemble entries from the test.

The app also supports the **bottom-up and top-down relations between the topical levels** described in section 4.2, as it enables physicians to **collect episodic as well as case based documentation** and **derive comprehensive topics** from them during collaborative reflection. The outcome documented in Figure 7(numbers 2 and 3) is an example of this, showing the comprehensive topic of coordinating relatives, which was derived from two episodic documentations (checked cases at number 1 in Figure 7). The other way round, the app can also be used for the reflection of comprehensive topics e.g. in meetings and there is a need to collect episodes to better understand the background of the topics.

5.3 Evaluation and Discussion

The evaluation of the app was done in a two-step approach, which was meant to provide formative information for a broad rollout in the hospital ward. First, we conducted a workshop with three physicians, who used an early prototype of the app and were asked to give feedback on its applicability and potential utility. In a second step, we conducted two workshop sessions with two physicians each. In these sessions, the physicians used an improved prototype in order to test-drive its rollout in the ward.

In the **first evaluation workshop**, we combined the elicitation of further requirements with an evaluation of an initial prototype of the app. In this workshop, three physicians took part, among which there was one young assistant physician, one experienced physician and the head physician of the ward. We asked these physicians about aspects such as motivation, topics and goals for collaborative reflection and gave them the opportunity to test the app. For the latter, we asked them to tell us about their impression on utility and applicability, missing or unnecessary features, proposals for improvement and situations in which they wanted to use it. As one result, the participants told us that overall they liked the idea of using this app to document and use case of relative talks – one physicians even said he and his colleagues might like the app because they can take it with them and use it during small leaks in their daily schedule (as opposed to doing all documentation at one after work). There were also proposals for improvement of the early prototype. For example, the form for sustaining reflection outcomes (Figure 7) is a result of these proposals. As a result of the trials in the workshop, the physicians also came up with proposals for organizational support of using the app for reflection. One of these proposals was to establish a regular meeting in which documented talks should be reflected on – according to one physicians, this would also motivate participation of physicians, as they would know that there is an event in which they get feedback on their talks from others. This does not only show the fit of the app into physicians' work but also indicates acceptance of the tool. Overall, the participating physicians stated that they liked the app and volunteered to take part in follow up workshops and a field test.

Figure 8: A physician using the TalkReflection App on a tablet device during the second evaluation workshop.

In the **second workshop**, in which three physicians took part (two form the first workshop and a different assistant physicians, while one missed the workshop because of an emergency case), we asked the physicians to work through a script. This script included the different phases of the collaborative reflection process blueprint (**Figure** 3) and linked them to the respective parts of the TalkReflection App. In particular, we sat the participants down on the same table and asked them to enter one or more experiences, to individually reflect on them and articulate outcomes of this reflection by adding comments to the documentation – this was done in solitude. Switching to a collaborative interaction mode, we asked them to share their material with the others, to annotate others' material and discuss the documented cases by referring to the documentation shared in the app. To conclude this collaborative reflection, they were asked to create an outcome as shown in Figure 7 by writing it down in the app and linking the material to it. This approach was meant to simulate app usage in the real context of the physicians. In addition, we asked them to focus on whether the app could foster their discussion and reflection and encouraged them to immediately report any problem.

After the workshop, we interviewed the physicians about their experiences with the app and about how it could be integrated in their daily work routines. In general they were satisfied with the improvements and were looking forward to using the app regularly. Thinking about situations in which they could apply the app to document cases and reflect on them, we developed a schedule for meetings in which case documented during daily work could be reflected collaboratively. Besides this plan, which shows that the app fits the needs of the physicians, they also proposed improvements, including further filter and search functions such favorites or to mark documentations as "done". In addition, they asked for stronger scaffolding of articulation and a more differentiated input form including selection options for categories of the talks (e.g. "Information", "Report about diagnostics", "Discussion about therapy options") in order to produce more structured documentation and better refer to it in later reflection. Moreover, they asked for a function to mark up certain parts of longer documentations separately, e.g. as good practice, and share these with others, differentiating between different groups to share content with. This again shows the adoption of the app and underpins the importance of articulation in the support of collaborative reflection.

While both of the evaluation workshops were conducted in a formative approach, they already show that the tool and the process it is based on can support collaborative reflection in healthcare workplaces: The physicians envisioned scenarios in which they wanted to use the app, they asked for adaptations to fit it even more to their needs and they liked the flexibility of taking the mobile app with them and documenting or reflecting in a time chose by them. This suggests that the intentions of the app as described in section 5.2 can be fulfilled in the hospital.

6. CONCLUSION AND FURTHER WORK

REFERENCES

In this paper, we have presented an approach in supporting collaborative reflection at the workplace as a mechanism to improve work practice and create knowledge in organizations. Regarding the lack of insights into the practice of collaborative reflection and tool support for it, we used an exploratory approach to shed light on this topic. In order to show concrete options of support, we focused the description on a study and application testing stream of our research done with a German hospital and complemented this with other studies done in parallel.

As we found, collaborative reflection at healthcare and other workplaces is characterized by a mixture of scheduled settings such as meetings or handover sessions and unscheduled occurrences of reflection such as spontaneous conversations on the hallway or reflection on the task currently performed. We also found that in healthcare work a special focus has to be set to unscheduled occurrences, as these happen more frequently than e.g. meetings. Based on this focus and a taxonomy for different modes of collaborative reflection, a model of topical levels in collaborative reflection such as episodic, case-based experiences and comprehensive topics and a process describing the steps and course of collaborative reflection in practice, we showed how tools can support this task in healthcare workplace by describing a prototypical built to support the reflection of physicians. As the evaluation of the tool shows, it suits the various needs of this workplace well and was embraced by the physicians. Given the general similarity of different modes of reflection and other aspects between healthcare and other workplaces, our results also suggest that the tool – adapted to other contexts – can be used as general support to understand conversations in daily work and improve them – examples could be talks with clients or suppliers.

The results presented here show how tools can support the documentation to prepare collaborative reflection can be supported in different contexts and how tools can support collaborative reflection in meetings. In further work, we will enlarge the application context of the app by evaluating its applicability in additional contexts such as spontaneous collaborative reflection. Moreover, we will evaluate it in different domains. Currently, additional evaluations are planned for domains such as care for the elderly, telecommunications and IT consulting.

7. ACKNOWLEDGMENTS

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