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ORIGINAL PAPER

A Social Regulation Perspective on Team Reflexivity: The Development of an Analytical Framework

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Abstract

Teams are nowadays seen as the cornerstones of organizations. Previous research has shown that team reflexivity is positively related to team performance. Traditionally, team reflexivity is conceptualized as a process that occurs during transition moments, ignoring reflexive moments during teams' action phases. Moreover, most studies used self-reported questionnaires and cross-sectional designs and thus provided limited insights into how team reflexivity unfolds during both the action and transition phases of teams. In this study, we adopt a social regulation perspective to develop an analytical framework to study team reflexivity in the flow of work. The study was conducted in a software development setting and included 50 h of video recordings of different types of team meetings of six professional self-managing teams (a total of 33 team members). Using concepts from social regulation theory as developed in student learning settings as an analytical lens, an analytical framework with four components of social regulation (knowledge co-construction and regulation; regulation activities; focus of regulation, and type of interaction) was developed and applied. Outcomes show that in more than half of their conversations, the teams jointly engaged in regulation-related activities, of which most concerned planning activities and a very low occurrence of evaluation activities. Different patterns of team reflexivity were found in the action and transition phase but zooming in on the interactions also showed high interrelatedness of the different activities. The analytical framework could assist future research to further study the interaction between the different components and how they mutually relate to team performance.

Keywords Team reflexivity · Social regulation · Team learning · Collaboration · Workplace learning

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Over the past decades, studies on teams and teamwork have flourished and shown the importance of teams to organizations while uncovering considerable knowledge about team-related processes and outcomes (Driskell et al., 2018; Hoegl & Parboteeah, 2006; Salas et al., 2018). Successful team collaboration highly depends on the processes team members engage in to direct, align and monitor their task work while interacting with each other (Marks et al., 2001). Especially in the field of software development, where teams rather than individuals are the basic unit of work (Moe et al., 2008), understanding the processes underlying successful workplace collaboration is greatly needed. Software development organizations are often seen as frontrunners in how to organize teamwork, as they were the first sector that adopted agile methods of working, in which the authority and responsibility to organize, plan, make decisions and improve their own performance lies mainly within the team (Dybå et al., 2014; Moe et al., 2009, 2010). The collaborative coordination and decision-making that are characteristic of self-managing teams require team members to be responsible not only for executing their tasks, but also for planning, monitoring and evaluating their team's performance (Moe et al., 2012). It is not surprising that the ability of the team to coordinate and evaluate their work and progress is linked to performance and the efficiency of teamwork (Hoegl & Gemuenden, 2001): the harmonization and synchronization of individual contributions are paramount for high-quality teamwork.

In research on teamwork, the construct of team reflexivity is often used to study "the extent to which group members overtly reflect upon, and communicate about the group's objectives, strategies (e.g., decision making) and processes (e.g., communication), and adapt them to current or anticipated circumstances" (West, 2000, p. 296). Positive effects of team reflexivity on a variety of outcomes such as performance, innovation and effectiveness have been empirically demonstrated, indicating that the extent teams overtly reflect upon their functioning positively impacts their collaboration (Konradt et al., 2016). However, the operationalization of the underlying framework is often very limited, focusing mostly on the evaluation part (see e.g., Otte et al., 2017; Schippers et al., 2014), leaving the coordination part (planning and monitoring) of team processes largely untouched. Moreover, many studies have adopted self-report measures and cross-sectional designs (e.g., Reiter-Palmon et al., 2018; Schippers et al., 2013; Yang et al., 2020) or used simulation and laboratory settings (e.g., Konradt & Eckardt, 2016; Li et al., 2021), proving valuable insight in influential input factors and outcomes of team reflexivity (Konradt & Eckardt, 2016), but limited understanding of how these processes evolve during teamwork. Therefore, a strong call has been made to adopt more fine-grained measures to better understand the dynamic character and interrelatedness of these team processes in the flow of work (Konradt et al., 2016).

At the same time, in the context of education, a strong line of research has developed focusing on students' joint planning, monitoring, and evaluation of their collaborative work, conceptualized as social regulation (Järvelä et al., 2019). Various studies have been carried out in student collaborative settings, using in-situ data that helped to understand the dynamic and cyclical character of these joint regulatory processes (Hadwin et al., 2017; Järvelä et al., 2019). Therefore, we argue that mobilizing this framework of social regulation as developed in the field of student

collaborative learning, will help to shed more light on the nature of collaborative coordination and evaluation of self-managing teams in the workplace. Using video captures of software development team meetings, a framework for the analysis of team reflexivity will be developed based on concepts from social regulation theory. In this way, we aim to extend the team reflexivity literature to include not only the retrospective evaluation of the work, but also include the continuous planning, monitoring and evaluation of self-managing teams in action.

Team Reflexivity as the Road to Success in Teamwork

With teams being the building blocks of organizations (Salas et al., 2018), many studies have aimed at understanding what makes teams successful in their work. Repeatedly, research has shown the importance of joint coordination and evaluation for teams to perform well (Konradt & Eckardt, 2016; Reiter-Palmon et al., 2018). Empirical work is often grounded in the widely accepted taxonomy of team processes proposed by Marks et al. (2001), in which a clear division is made between the action phase in which teams engage in task work while monitoring their progress, and the transition phase between tasks in which time is spend on evaluating on past performance and planning towards the next goal (Driskell et al., 2018). Regarding the action phase, research has demonstrated the beneficial role of monitoring activities, for example improving team performance via increased coordination and feedback processes (Marks & Panzer, 2004), as a mediator between team efficacy and performance (Rapp et al., 2014), or increasing both performance and motivation and satisfaction of teams (Geister et al., 2006). Concerning the transition phase, studies have demonstrated the value of planning for team performance, via, for example improved coordination and interpersonal processes (see e.g., Fisher, 2014; Kleingeld et al., 2011; Mathieu & Rapp, 2009), and a possibly curvilinear relationship between planning and performance (in-process planning initially increasing performance, whereas too much planning negatively effects performance) (Lei et al., 2016), and a link between different types of planning and team effectiveness is made (DeChurch & Haas, 2008). However, most studies seem to focus on either the action or transition phase or, even narrower, on just one of the segments of the coordination and evaluation process, suggesting that the different elements of reflexivity occur sequentially and can be separated (Schippers et al., 2018). However, it is likely that these segments occur in a highly interrelated and interwoven form as teams inspect and adapt in a continuous cycle responding to their dynamic environment (Schippers et al., 2018; Schmutz & Eppich, 2017; Schmutz et al., 2016). Even though there is awareness that these components together represent a joint set of interrelated processes that dynamically affect each other (Gabelica et al., 2014; Otte et al., 2018), a fine-grained operationalization is missing allowing for this type of analysis (Konradt et al., 2016) and empirical work investigating these important processes in unity in the flow of work is lacking. In line with Otte et al. (2018) and, we propose that the team reflexivity processes take place during both transition and action phases of teamwork and should be studied accordingly. For example, self-managing teams need planning skills during the transition phase to prioritize tasks and assign them

to the appropriate team member at the right time, they need monitoring abilities during the action phase to constantly check their progress and align their collaboration towards goal attainment and need evaluative activities during the transition phase to effectively engage in an inspect and adapt cycle (Dybå et al., 2014; Stray et al., 2011). Capturing all of these processes in unity might allow studying their interrelatedness and improve our understanding of how they jointly affect team functioning (Otte et al., 2018).

Social Regulation as an Analytical Lens for Studying Team Reflexivity

In the context of education, these team coordination and evaluation processes have been studied extensively in student teams working on collaborative tasks. The basis of the conceptualization of these coordination processes is grounded in educational psychology, building on more than 20 years of research in self-regulated learning (Hadwin et al., 2017; Zimmerman & Schunk, 2011). Underlying most definitions of self-regulated learning is the assumption that it involves a cyclical process in which learners take actions with purpose, intent and goals, while adaptively responding to situations (Hadwin et al., 2017), and that when students plan, monitor and evaluate their learning, they will learn more effectively (Panadero, 2017). Since student learning takes more and more place in collaborative settings, bringing together multiple self-regulating individuals, this requires them to regulate not only their intra-individual processes, but their interpersonal behaviours as well, to align their efforts in order to meet their joint goals (Lord et al., 2010; Volet et al., 2009). The growing idea that regulation during collaboration addresses more than the sheer self-regulation of individual team members has slightly shifted attention to the conceptualization of *social regulation*, referring to intentional and goal-directed group efforts to regulate group work in the service of a shared outcome (Hadwin et al., 2017; Rogat & Linnenbrink-Garcia, 2011).

Even though the aim of collaborative tasks in school settings is development of knowledge and skills, while workplace teams often work towards the development of new products or services, the value and importance of these regulatory skills is recognized in both contexts. For over a decade, self-regulatory mechanisms are seen to enable employees to function adequately and efficiently in the workplace and to gain the necessary skills and knowledge to realize their potentials (Gijbels et al., 2010; Sitzmann & Ely, 2011). Workers are required to function under the constant pressure of time and deadlines, and they need to deal with multiple tasks and sometimes conflicting goals at the same time (Lord et al., 2010). Moreover, they do not do this in isolation: workers often need to collaborate with team members with whom they share goals and responsibilities (Vangrieken et al., 2017), requiring them to collaboratively coordinate and evaluate their work. As fine-grained analysis of these regulatory team behaviours is still missing in the field of workplace learning, we will adopt the framework of social regulation as an analytical lens to study team reflexivity. Previous studies that have analysed micro-behaviours of social regulation in student teams (e.g., Grau & Whitebread, 2012; Molenaar, 2011; Molenaar & Chiu, 2014) revealed different components of social regulation that are crucial for

explaining differences between teams in terms of the quantity and quality of social regulation and differences in team performance. After reviewing the literature on social regulation, we identified four important components to be further explored for developing a framework for analysing team reflexivity in the flow of work.

Component 1: Regulation Versus Knowledge Co-construction

A first step in the operationalization of social regulation and determining what social regulation is exactly, is clarifying what it is not. One of the challenges in examining regulation, indeed, is to make a clear distinction between regulatory activities and cognitive activities, as both concepts are closely related and sometimes seem to be intertwined (Azevedo, 2020). In previous research, many different terminologies for these cognitive activities have been used (see Mohammed et al., 2010), such as cognitive emergent states (Marks et al., 2001) and shared mental models (Van den Bossche et al., 2011), all assuming that a joint understanding about the task on a cognitive level is necessary for effective shared regulation (Konradt et al., 2016). In fact, these cognitive activities are theorized to be essential for effective regulation and team performance, as accurate shared understanding and compatible views of the task provides essential input for reflexivity activities (Konradt et al., 2016; Schippers et al., 2018). However, most studies examining regulation processes have operationalized regulatory or metacognitive activities, but did not state how to distinguish these from the many cognitive activities also present during team collaboration (e.g., Grau & Whitebread, 2012). What the few studies in which both types of activities were distinguished have in common is that cognitive activities were defined as activities dealing with the content of the task, whereas regulatory activities were described as the regulation or controlling of those cognitive activities (e.g., Iiskala et al., 2015; Meijer et al., 2006; Molenaar & Chiu, 2014). This is in line with the notion proposed by Nelson (1996) that cognitive activity takes place at the *object level*, which is governed by activities on the *meta level*. Therefore, to guarantee the discriminant validity of the analytical framework, we will define the cognitive activities involved in teamwork, that is, knowledge co-construction, as activities directed at the content of the task and the elaboration of this content, situated at the object level.

Component 2: Regulation Activities

What most conceptualizations of social regulation have in common is that it concerns a process in which different activities alternate in a general time-ordered sequence (Hadwin et al., 2017). First, planning in generally refers to setting goals and determining which strategies to use in order to reach the goal (Sitzmann & Ely, 2011). Such strategies include discussing how to go about solving problems, determining task directions, and translating these directions into a clear plan (Rogat & Linnenbrink-Garcia, 2011). Second, monitoring refers to assessing progress, recognizing what remains to be completed and monitoring the pace and time remaining (Rogat & Linnenbrink-Garcia, 2011). As Hadwin et al. (2011) defined it, monitoring

concerns the comparison of a current state with a desired state. Finally, evaluation is when learners reflect and a judgement about goal attainment and performance is made (Pintrich, 2000). With regard to the cyclical nature of regulation, conclusions from monitoring can spark the need to revisit the planning activities, and conclusions from the evaluation activities might influence the following planning activities. The above mentioned regulation activities, defined from the social regulation perspective, closely resemble the team processes brought forward in the team reflexivity research, such as analysing the task, specifying goals, strategy formulation and planning courses of action possibly prompted by reflections on previous performance, and tracking progress and identifying possible shortcomings towards goal attainment (Driskell et al., 2018; Konradt et al., 2016). Applying the social regulation activities to the team reflexivity framework, the dynamic timeline a team goes through can be described as cyclically flowing from one performance episode to another (i.e., the action phases) in which teams engage in monitoring activities while tracking their progress, interspersed by moments of transition (i.e., the transition phase) in which teams deliberately evaluate their past performance and set their goals and plan the upcoming action phase.

Component 3: Focus of the Regulation Activity

In teamwork, a broad array of topics are addressed: on-task discussions alternate with discussions about the progress of the meeting and social interactions, for example. This also means that the regulation activities can have different foci In a few studies investigating regulatory processes during collaboration in student teams, attention has been paid to the focus of the regulatory activities. Janssen et al. (2012) distinguished between regulation directed at task-related activities and regulation focused on social activities. The results showed that students mainly devoted their interactions to regulating task performance; the regulation of the group process occurred least frequently. This finding was explained by the complexity and size of the tasks performed by the students, which required students to plan and monitor their progress thoroughly (Janssen et al., 2012). A second important finding was that the regulation of social activities, such as planning and monitoring the collaboration, could be linked to group performance, indicating that regulating the group process results in better group performance. Grau and Whitebread (2012) also differentiated between different foci of regulatory processes. In their study, primary school children focused their regulatory activities mainly on surface aspects of the task, instead of fundamental aspects. In addition, only 20% of their regulatory activities were directed at organizing the group work (Grau & Whitebread, 2012). The value of differentiating between different foci has also been shown in the workplace literature, for example by Mathieu and Rapp (2009), showing that engaging both in teamwork plans (i.e., referring to matters such as how the team will work together) and plans directed to task work (i.e., activities concerning performance strategies for the task) are linked to performance. In addition, Fisher (2014) showed that planning directed to task work impacts coordination processes, whereas planning directed to teamwork affects interpersonal processes, both indirectly influencing team performance.

This demonstrates that distinguishing between different foci of regulatory activities provides more detailed information on what is going on in collaborative groups and might provide deeper understanding of the relation between regulation processes and team performance.

Component 4: Types of Regulatory Interaction

For teams to engage in collaborative and joint regulatory activities, communication and effective interaction between team members are required (Schmutz & Eppich, 2017). Team reflexivity research has shown the vulnerability of the collective character of the process, as team members are seen to fail to share important information or fail to elaborate on this information causing information processing failures and thereby poorer performance (Schippers et al., 2014), Investigating to what extent regulatory activities are shared and elaborated upon between team members might uncover important collaboration mechanisms explaining performance (Schmutz et al., 2018). In line with this, social regulation research has shown that, besides focusing on how social regulation is manifested, it is also important to investigate how these activities are embedded in interaction by tracking how a regulatory statement is followed by others (Grau & Whitebread, 2012; Molenaar, 2011). For example, Molenaar (2011) differentiated between *ignored*, *accepted, shared* or *co-constructed* regulatory activities. An ignored regulatory activity refers to a situation in which a team member intends to regulate the group's activities, but the other team members ignore this intention by, for example, not responding to a regulatory utterance during a group discussion. As Rogat and Adams-Wiggins (2014) indicated, although ignored regulation might sometimes be inherent in the natural flow of collaboration, a high frequency of this type of communication might be indicative of low-quality interaction. Accepted regulation occurs when team members react to a regulatory utterance by replying with a cognitive contribution, showing that the regulation activity was noticed and acted upon. Shared regulation refers to a situation in which team members share regulatory ideas and respond to each other's input; however, it does not reach the state in which they build on each other's ideas towards creating a new idea, which is called co-constructed social regulation (Molenaar et al., 2014). In other words, findings from research on both social regulation and team reflexivity suggest that the type of regulatory interaction is crucial for high-quality coordination and evaluation processes in teams.

Present Study

The premise of our study is that within self-managing teams, team members engage in collaborative and joint regulatory activities to reflect on shared objectives and strategies. The aim of the present study is to develop a framework suitable for analysing team reflexivity of self-managing teams as it unfolds in real time in a natural setting, reflecting the full complexity and diversity of the team activities involved in both the action and transition phase. While developing the framework, we aim to be

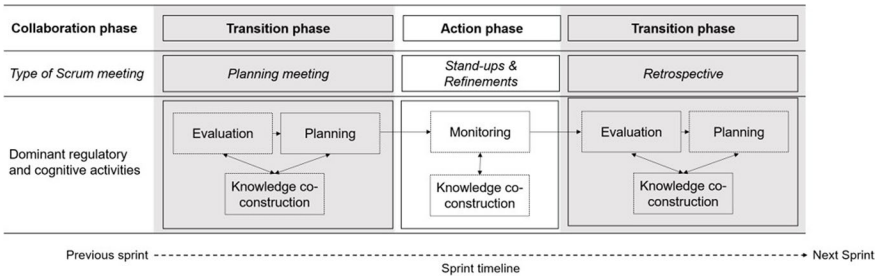

Fig. 1 Scrum timeline and corresponding collaboration phases and dominant activities

transparent about our construct definitions and offer thick descriptions and concrete details about its application in order to achieve transferability and invite reproductivity (Dent & Hoyle, 2015; Tracy, 2010).

Integrating previous research in student learning settings (Hadwin et al., 2017) and prior work in the workplace setting (Driskell et al., 2018; Konradt et al., 2016), we assume that different phases of regulation (i.e., planning, monitoring, evaluation) can be identified. Further, both strands of research have demonstrated that distinguishing between different foci of regulatory activities (e.g., task, process) provides us with more detailed information on different aspects of regulatory activities (Grau & Whitebread, 2012; Mathieu & Rapp, 2009). Finally, we build on the work of (Molenaar, 2011) on computer-supported collaborative learning (CSCL) and expect to find different types of interaction, depending on how team members react to each other's regulatory input. However, a fine-grained operationalization of these constructs, representing their interrelated working is lacking (Konradt et al., 2016), even though calls are being made to examine the full cycle of team reflexive behaviours (Otte et al., 2018). Applying the fine-grained social regulation operationalization lets us move away from the often very general measure of team reflection, underspecifying the complexity of these team processes.

To develop and further refine the framework, we analyse the meetings of self-managing teams of engineers who deliver software products in brief iterations (*Sprints*) of two to three weeks, following the management method called Scrum. The Scrum setting is particularly interesting for investigating the manifestation of team reflexivity in both action- and transition phase, as it involves a project-management-oriented agile development method in which the team itself is responsible for planning, assigning tasks and making decisions going through short iterations of performance episodes (i.e., a Sprint) (Moe et al., 2010). Furthermore, there are several prescribed events that take place during a Sprint, either during the action or transition phase, allowing us to study these processes in their natural setting. The timeline of the Scrum method can be described as follows (see Fig. 1): first, when transitioning from one Sprint to the next, the team starts with a Sprint Planning meeting in which the work that has to be performed during the Sprint is planned, resulting in a list of prioritized features the team will deliver during the iteration. During this meeting, the team discusses what tasks (also called *stories*) need to be performed to develop a feature and estimates the amount of time needed to deliver it (Dybå et al., 2014; Sutherland & Schwaber, 2013). During

the action phase of a Sprint, daily short monitoring meetings, called Stand-ups, are held, in which the progress toward the goal of the Sprint is monitored. This is a time-boxed event lasting a maximum of 15 min, preferably held at the same time and place each day to reduce complexity (Sutherland & Schwaber, 2013). Team members typically answer questions such as "What did I do yesterday?", "What will I do today?", and "Do I see any impediments?". After completing the Sprint, an evaluative meeting, called Retrospective, is organized, during which the team reflects on what went well and what could be improved, with the goal of improving future practice. The objective of the meeting is to identify potential improvements and make plans for implementing these improvements in the next Sprint (Dybå et al., 2014; Sutherland & Schwaber, 2013). Lastly, if needed, the team can schedule longer monitoring meetings during their action phase, called Refinement sessions, when estimates need to be revised or details about certain stories need to be added during the Sprint. By videotaping the different meetings, we can observe how these self-managing teams regulate their collaboration during action and transition phases, without changing or intervening in their natural way of working.

The specific research question we aim to answer is: How do self-managing teams in the workplace jointly coordinate and evaluate their collaboration towards their project goals? The components characterizing the nature of team reflexivity during team meetings in the workplace will be described and used to develop and refine the analytical integral framework for studying team reflexivity.

Method

Participants

Data were collected from six software development teams from two different companies in the Netherlands. These teams had, on average, 5.5 members ($SD = 1.52$). A total of 33 team members participated (87.9% male), with a mean age of 39 years ($SD = 7.34$). All teams consisted of both developers and testers with either a higher vocational education or academic degree. As explained before, the teams under study are self-steering and no hierarchy exists between team members. In each team, one member served as a so-called Scrum master, with the additional task to plan the meetings and communicate with the client. As this is time consuming, in most teams this additional duty rotated between members every Sprint. Further descriptive information for the teams is provided in Table 1. All teams were existing teams and were created by the company they worked for without interference by the researchers. By not manipulating the team composition, we aimed to enhance ecological validity and reflect a real context (Hadwin et al., 2004).

Procedure

The management teams of both organizations were informed about the purpose and procedure of the research during a presentation. They then informed the software

Table 1 Descriptive information teams

	Team size	Gender		Age in years		Longevity	
		Male	Female	*M*	*SD*	*M*	*SD*
Team A	3	3	0	50	8.96	6.67	5.86
Team B	6	6	0	39	7.07	8.6	3.78
Team C	5	5	0	36	2.17	10	7.26
Team D	7	5	2	39	8.76	3	1.95
Team E	5	4	1	41	5.91	3	1.08
Team F	7	6	1	38	6.03	3	1.08

development teams about the aim of the study, and teams were asked to sign up to meet with the researcher(s) if they were interested in participating. This was on a voluntary basis, and the management teams did not pressure the development teams to participate. In the meetings, the researcher(s) explained to each team individually the aim of the study, the method of data collection, the time the teams needed to invest, and how their privacy would be protected. After this, the teams were free to decide whether they were willing to participate in a pilot study for two weeks, prior to the main study, in order to experience the method of data collection. It was made clear that the team would participate only if all team members gave their permission individually. A total of eight teams (four in each company) decided to participate in the pilot study. After the pilot period, a total of seven teams decided to continue to participate in the main study; one team reported that the end date of their contract was before the end of the main study and therefore they felt participating would not be meaningful for them. During the data collection, one team was dismantled by the company; therefore, the data for this team were incomplete and not included in the study, resulting in a final sample of six teams. At the beginning of the data collection, all team members signed an informed consent form ensuring their understanding of the implications of their participation. To safeguard their privacy, confidentiality was guaranteed.

Data Collection

The data used in this study consisted of video observation data from the teams' meetings. All meetings were focused on discussing the progress of the software development process. The teams were videotaped with 360-degree cameras during a total of 100 meetings with a duration of between 10 and 120 min, resulting in almost 50 h of video recordings. In Table 2, an overview is given of the number of different types of meetings videotaped during this study, and their total and mean durations.

During the pilot study, the teams familiarized themselves with the camera and the research team. Interactions noted on the videotapes, such as complaining about the management of the company or discussing private family matters, indicated that the participants felt safe and behaved realistically.

Table 2 The number of videotaped meetings and their total and mean duration, by type of meeting

	N	Total duration (hours:minutes:seconds)	*M* (*SD*) (hours:minutes:seconds)
Planning	10	15:40:10	01:25:28 (00:34:10)
Stand-up	64	09:47:00	00:09:10 (00:03:20)
Refinement	10	11:02:08	01:13:34 (00:40:08)
Retrospective	16	13:53:50	00:49:03 (00:23:39)

Analysis

Coding Protocol

The 100 videotaped team meetings were coded, using the Observer XT software (Noldus Information Technology, v15), allowing for direct coding of video data. The software provided us with time-logged codes and the frequencies and durations of those codes. Portions of the coded videotapes were transcribed and translated into English for the purpose of providing examples. Pseudonyms were used in the transcript to protect participants' identities and XYZ and UWV were used to replace the name of a particular work item to protect team identity.

To answer the research question, we carried out a problem-based content analysis (Krippendorff, 2018). We used the existing social regulation framework as described in the Theoretical Framework to provide our initial analytical constructs. During several iterations, these constructs were modified, extended, and deepened. Below, we describe the main steps of our analysis. The first step in the coding protocol concerned segmentation into episodes. We defined an episode as a sequence of utterances about the same subject (Molenaar, 2011). An episode begins with the first utterance concerning a new subject and ends with the last utterance about that topic. Conversation about a topic can be briefly interrupted by social talk. This step did not yet focus on the identification of regulatory activities. This meant that there could be episodes without regulatory activities.

In the second step, we started identifying social regulation activities at the level of single conversational turns and categorizing the nature of these activities by addressing the four aspects of social regulation that we identified from the literature. Addressing the first aspect involved distinguishing social regulation contributions from knowledge co-construction input and off-task comments. Social regulation was operationalized as intentional and goal-directed group efforts to regulate the team's joint conceptual understanding and task work (Hadwin et al., 2011; Rogat & Linnenbrink-Garcia, 2011). Knowledge co-construction was characterized as activities directed to the content of the task, situated at the object level (Nelson, 1996). Addressing the second aspect involved analyzing the regulatory activities, conceptualized following the widely accepted model including three main activities, namely, planning, monitoring and evaluation. Addressing the third aspect involved distinguishing between the different foci of regulatory activities. Based on previous research we expected regulation contributions to be focused either at task

performance or at group processes (e.g., Grau & Whitebread, 2012; Janssen et al., 2012). Finally, we analyzed across single turns to determine the type of interaction based on the categories developed by Molenaar (2011), distinguishing between ignored, accepted, shared and co-constructed activities. While these codes were grounded in previous research within an academic context, we remained open to additional activities we would observe for this sample, given the different context. We developed and tested the coding scheme by extensively and iteratively applying the above-described concepts, while modifying the scheme and adapting definitions to suit the context of this study.

Together, the above-described components form an analytical framework for analyzing team reflexivity in the workplace, differentiating between social regulation versus knowledge co-construction, and identifying different regulation activities, the focus of regulation and types of regulatory interaction. In Fig. 2, a visual representation of the framework is displayed. When using the framework, the data are segmented during data preparation both on the level of single turns and on the level of episodes. On the level of a turn, every utterance receives an identification code to connect it with the corresponding team member. Episodes are defined as a sequence of utterances that deal with the same subject. An episode begins with the first utterance about a new subject (coded as 'initiating'), and ends with the last utterance about that topic. This step does not yet focus on the identification of regulatory activities, which means that there can be episodes without regulatory activities. An episode may be briefly interrupted by off-topic talk.

In the first coding step, every utterance is assigned to one of three categories: social regulation, knowledge co-construction and off-topic conversation. In the second and third steps, only the social regulation utterances are assigned a phase and a direction of activity code. In the fourth step, the type of interaction is determined. Social regulation utterances can be either initiating, ignoring or engaging types of interaction, whereas knowledge co-construction can be accepting or ignoring when they fit the definition, and off-topic utterances can only be ignoring if they fit the description.

Reliability of Coding Procedure

During the development of the codebook, the team of researchers continually compared their results and discussed their choices until agreement was reached. When a new sub-code was identified or a sub-code was revised, the videos were recoded to reflect these changes. A pool of four coders were intensively trained with the final coding scheme. The inter-rater reliability was established by recoding 10 meetings (about 10% of the total meetings) and then comparing these codes with those already assigned (Cohen's $\kappa = 0.97$).

Chi-square Tests

To analyze the relation between the occurrence of regulation activities and the different foci of activities and interaction types, chi-square analyses were carried

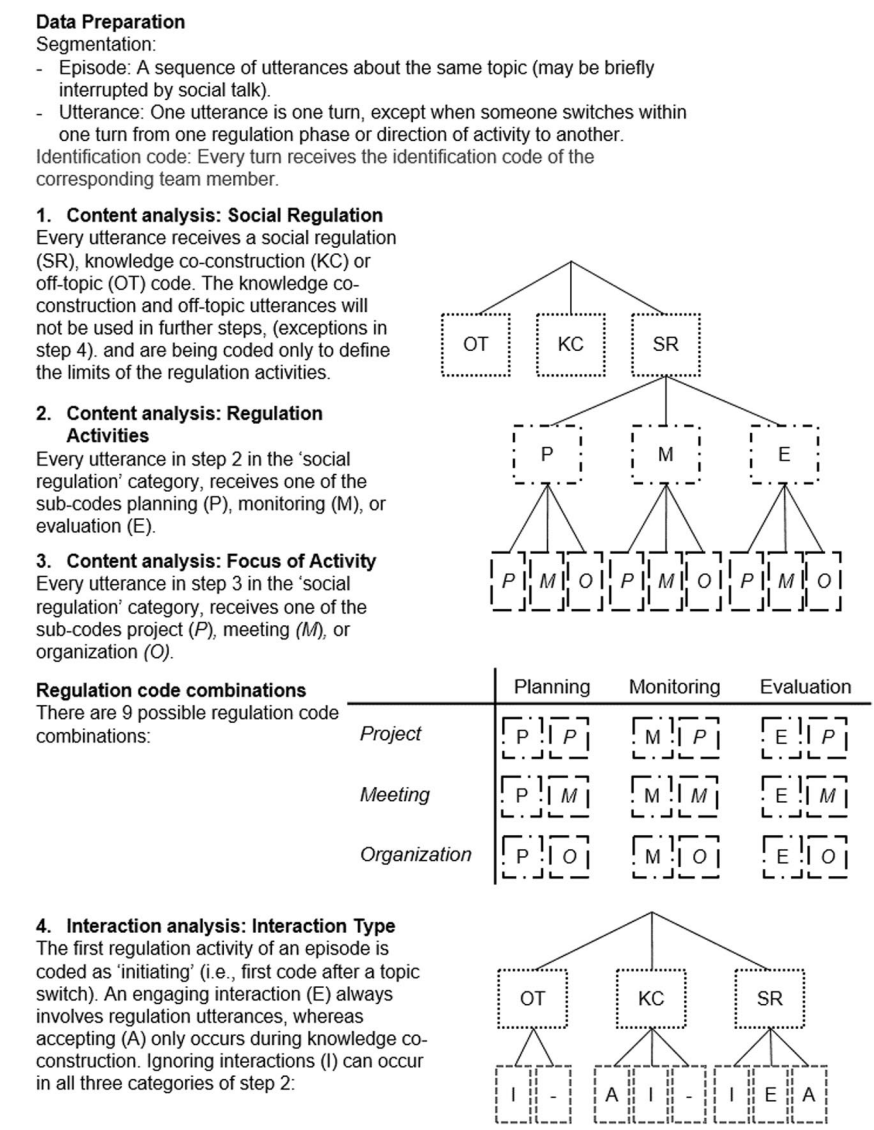

Fig. 2 Analytical framework step-by-step

out. In addition, the results were examined post hoc using Haberman (1973) adjusted residuals to identify the specific cells in the crosstabs that significantly deviated from the expected frequency. To correct for Type 1 error due to the multiple comparisons, Bonferroni adjusted alpha levels and corresponding z critical values were calculated. An adjusted residual with a value exceeding the z critical value indicates a significant deviation from the expected frequency.

Table 3 Example of an episode during a Stand-up meeting

	Team member	Utterance
1	Tobias	Okay, let's see how we are doing, let's start with the most important things
2 3	Tobias	Issue 1 has been solved by Ryan, and I have tested it and I think it functions like it did before. I solved Issue 2, Harry, you are testing it?
4	Harry	Yes. And Issue 3 is a work in progress, still working on that
5	Ryan	My story, I haven't merged it yet to the masterpiece
6	Tobias	Which story?
7	Ryan	The one with the patch
8	Tobias	Ohhh, okay
9	Nick	Is that a backhand patch?
10	Ryan	No, it is a straightforward patch with the basic functionalities of XYZ
11	Tobias	If that patch is ready, do we need to deliver it?
12	Robin	Yes
13	Tobias	Harry, it's your turn
14 15	Harry	Yes, I am not making much progress on Issue 4, because I can't manage to save the UVW. I keep getting the same error message as I did Thursday
16	Tobias	You tested it this morning?
17	Harry	Yes
18	Tobias	Oh, well, I will fix that immediately then
19	Harry	Okay, and if that goes fairly quickly, I can follow up on Issue 5
20	Tobias	You are working on this story? [pointing at the screen]
21	Nick	Yes
22	Tobias	Ooh, this is one you still need to test, Harry
23	Harry	Let me think… Oooh, that's the one with a few very small bug fixes
24	Robin	Just a few cosmetic fixes
25	Tobias	If you could do that quickly, I would do that first
26	Ryan	We need to go over that after we are done here, just tune in together
27	Harry	Okay
28	Ryan	I expect to be finished with this code today

Results

In this study, we examined the nature of team reflexivity during team meetings in the workplace. To give a clear image of what the data in this study looks like, two examples of episodes (where an episode is a set of utterances concerning a single topic) are presented below, showing a typical discussion from a brief meeting (Stand-up meeting) and one from a longer meeting (Refinement session). In the example displayed in Table 3, we see that team members use a variety of different regulatory activities during their Stand-up meeting. The team is monitoring its progress (e.g., lines 2–3 and 14–15) and planning future steps (e.g., lines 19, 25–26), but they also share content knowledge by clarifying things on an object level (e.g., lines 9–10). Furthermore, we see that after the first utterance and line 13 in which Tobias regulated the meeting, the rest of the regulation is focused on the task.

In the example below (see Table 4), a brief episode is displayed from the same team during a Refinement meeting. In this example, we see much more focus on content and less on regulation. The episode begins with planning statements in which the team is discussing the steps they need to take (e.g., lines 3 and 4), but later, after Ryan shares his idea about a certain functionality (lines 6–10), the team is discussing the specific substantive details of a feature they are working on (e.g., lines 11–22).

First, the nature of the distinctive aspects that emerged from the data will be described, including examples from the data. This is followed by an overview of the extent to which each of the categories was represented in the different types of meetings.

Component 1: Social Regulation vs Knowledge Co-construction

The first step was to select utterances concerning social regulation from those involving knowledge co-construction and off-task communication. We were able to apply the same set of codes formulated in the foundation for the analytical framework based on the literature review. Definitions, examples and frequencies are shown in Table 5. In total, 22,786 utterances were coded. More than half of the utterances were coded as social regulation (52.54%), followed by knowledge co-construction utterances (40.82%). Only 6.64% of the utterances were off-task activities in which team members engaged in social talk, discussed personal matters or made jokes.

Component 2: Regulation Activities

In the second step, the social regulation utterances were further categorized according to the different regulation activities. No changes to the foundation of the analytical framework were necessary and the definitions that were proposed based on the literature review could be applied unaltered. In Table 6, definitions, examples and frequencies of the codes as used with these data are given. Planning occurred the most often (60.90%), followed by monitoring (24.23%). Only 14.88% of the regulation utterances concerned evaluation. A more in-depth description of how these three phases manifested themselves in the context of teamwork in the workplace will be given.

Planning

We found many examples of planning statements that were focused on matters concerning the planning of sub-tasks (e.g., “Then we have to include that in the next Sprint” and “First we have to do XYZ and then UVW”) and discussing strategies for how to perform a certain task (e.g., “For that status, everything substantive must be done properly”, “Perhaps we can approach it as one big story?”, “If there is room for one more than we add the one at the top”). Specifically in the Stand-up meetings, planning statements were characterized by a focus on the allocation of tasks (e.g., “Could you do that?” “I will make sure I keep the burndown chart up-to-date”).

Table 4 Example of episode during a Refinement meeting

	Team member	Utterance
1	Tobias	Let's see what is already in the right status
2 3	Ryan	Ooh, right, I haven't done the status updates yet, but I did make additions to them. I would suggest starting with Issue 1
4 5	Tobias	That's the most important one. Let's start from the top. Sorting the search screen by starting date. At the moment it happens by default I think?
6 7 8 9 10	Ryan	There is a search screen and the default sort is the starting date and then the code, and that is confusing for people, because you get a list with 1, 2, 3, 4 and then 5 has a different starting date and suddenly disappears to the end of the list. In practice, the starting date doesn't matter at all because you always only get the most recent point. So the starting date is not relevant, as it always gives you the most recent version
11	Tobias	So it should only be sorted on code. I will add it to the story
12 13	Ryan	And because it doesn't matter, I wrote down, just put it in the last column, as it is now in the first column
14	Nick	Oooh, this is not such a configurable thing where people can determine themselves…
15	Tobias	No, it's not
16	Ryan	That's not necessary
17 18	Nick	But this screen is maybe accessible from multiple angles in the final application, is it always the case then?
19 20 21	Ryan	For the normal method of use it is not relevant, because you always want the newest one, except maybe in an exceptional case, but no, you can't even choose another one. Only for management purposes maybe, but that is incidental
22	Nick	Okay

Table 5 Definitions of codes for step 1, examples, and frequencies

Codes	Definition	Examples	Frequency
Social regulation	Intentional and goal-directed group efforts to regulate the team's conceptual understanding and task work	"Well, it needs to be finished before the end of the Sprint, but not necessarily this week." "Let me first check if I checked everything in."	11,971
Knowledge co-construction	Activities directed at the content of the task and the elaboration of this content, situated at the object level	"It is very rare that such a violation occurs." "The XYZ is written at 1.3." "You need multiple solution directions for this." "There is a certain structure in the activity table that is especially important for reports."	9302
Off-task communication	Comments not related to the content or process of the task	"The table is broken, but that's because there's a clumsy person sitting behind it." "You should lick your pen to get it working."	1513

Table 6 Definitions of codes for step 2, examples, and frequencies

Codes	Definition	Examples	Frequency
Planning	Discussing how to go about solving problems, goal setting, collaboratively discussing task directions, translating directions into a clear plan including scheduling, and designating task responsibility	"We need to check what we need to do today."' "Can you do the XYZ review?" "I will do the other story and then we can finish both of them."	7290
Monitoring	Monitoring content understanding, comparing a current state with a desired state (goal standard), assessing progress, recognizing what remains to be completed, and monitoring the pace and time remaining	"How far along are you with that task?" "I finished the XYZ from the home screen."	2900
Evaluation	Making a judgement about goal attainment, discussing what could be improved next time	"Our area of weakness is communication. Communication within the team is not always positive, I mean." "I think, yeah, structurally you see that we are handling it wrong."	1781

Only a few instances occurred in which prior knowledge was activated (e.g., "We have done this before, it took a lot of time then"); this happened particularly in the Retrospectives.

Monitoring

It is noteworthy that most monitoring utterances were directed at giving and asking for progress updates ("Yesterday I resolved the bug and worked on the XYZ"). In Stand-up meetings this was especially demonstrated by statements focused on monitoring which tasks remained to be done to complete the task or Sprint (e.g., "Did you already look at that?", "You found that branch, did you?"). Checking the comprehension of a task happened rarely ("I don't understand, can you elaborate on that?").

Evaluation

In this study, evaluation utterances seem best characterized as focusing on evaluation of a team member's or one's own skill, attitude or work (e.g., "He quickly learned everything and adapted well to our team", "He says that he wants to speak with you after a Stand-up, but he never does"), and the efficiency and effectiveness of the work process (e.g., "We did a bad job in preparing for the demonstration", "We've done all the tasks for this Sprint, thus the Sprint is completed", "I think it is good that we decided to stop with adding new stories to the Sprint"). It only rarely happened that judgements were made about the product itself (e.g., "The users are very enthusiastic about the use of the application", "The surrounding of XYZ is nice and stable", "I'm satisfied with the way we fixed the URL's, we have worked hard"). It is noteworthy that discussing what could be improved in the next Sprint did not occur as often as might be expected, considering the fact that that is one of the explicit goals of Retrospective meetings. In Table 7, an episode is displayed during which team members discussed strategies on dealing with points for improvement, illustrating the struggle the teams experienced in this area. Max is concerned about what will be done with the evaluation points they discussed during a Retrospective. He suggests planning a new meeting to talk about action points to improve the points that were mentioned in the evaluation, but William wants to act the same as always and just wait and see what can be done about it. Table 8 shows an episode illustrating how teams sometimes struggled with taking the objective of evaluation moments seriously.

Component 3: Focus of Regulation Activity

The original set of categories we used as a point of departure was developed by Grau and Whitebread (2012) and described the regulation of the task, the organization of the group work, and the socio-emotional aspects. When coding the data, we did not find evidence of regulation of the socio-emotional aspects, and therefore, that category was not applied. Most of the regulation utterances were about

Table 7 Example I of an episode with evaluation utterances

Team member	Utterance
Max	So far, we only have one evaluation point with a direct action point linked to it. We have also discussed the other evaluation points. I think we shouldn't just say, well, something should be improved about this. I think we have to try to make action plans for all evaluation points. Maybe we can plan an extra meeting for that?
William	Well, I actually wanted to do it as before. Last time we discussed what we think are the most important evaluation points
Max	So you mean, we only choose a couple of points to work on?
William	Yes, exactly
Max	But, when you take, for example, velocity. That is an evaluation point, but it is not an action point yet. What should we do with that?
William	Well, then we'll see what we can do about it

Table 8 Example II of an episode with evaluation utterances

Team member	Utterance
Liam	The thing that you have to ask yourselves is what went well and what should we keep doing next time
Mason	Cake
Elizabeth	That's not work-related
Logan	But you may say everything. Everything!
Liam	[funny voice] Person B is a nice guy
Mason	If somebody says that, I expect it to be very cynical. [laughs]
Elizabeth	Velocity was okay, despite…
Logan	We have an hour for this, right?
Oliver	Less would be nice. [everybody laughs]

the project they were working on (e.g., discussing how to best approach the work and investigating their progress). Second, there were instances in which the team regulated the meeting itself, for example, by discussing how to approach the timetable for the meeting, agreeing on the agenda for the meeting (which topics to discuss and when) and deciding on speaking turns. Therefore, we added the category *meeting organization* to our codebook. Third, there were moments during which the team regulated the organization of collaboration on a more managerial/administrative level, for instance, by checking who would be in the office when and discussing the structure of their working method (e.g., which meeting to schedule when and who should be present). Therefore, the regulation utterances in this study were coded as directed toward regulating 1) the *project*, 2) the *meeting,* or 3) the *collaboration process*; see Table 9 for a description of the codes. Regulatory activities were mostly directed at regulating the project (88.79%), followed by regulating the meeting (9.20%); only 2.03% of the regulatory activities were directed at regulating the organization of the collaboration.

To explore the relation between the occurrence of regulation activities and the different foci of regulation, a crosstab was made and chi-square analyses were carried out. The crosstab (Table 10) and chi-square analyses showed that as well the project, the meeting and the organization was planned, monitored, evaluated, but that the relative distribution of activities differed significantly ($\chi^2(4) = 1959.38$, $p < 0.001$). The effect size for this finding, Cramer's *V*, was 0.29, which can be considered as moderate (Cohen, 1988). In order to determine whether the observed frequencies were significantly different than the expected frequencies, post-hoc analyses were done using Bonferroni adjusted alpha levels of 0.0056 and the corresponding z critical value of -2.77. Results are displayed in Table 10, showing the observed frequencies (OF), expected frequencies (EF), percentages, and adjusted residuals (AR).

The post hoc analyses showed that planning utterances were relatively more often directed at regulating the project (OF = 6917, EF = 6472.76, AR = 26.37) and organizing the collaboration (OF = 187, EF = 147.98, AR = 5.05) and relatively less often directed at regulating the meeting (OF = 187, EF = 669.26, AR = -31.28). The same was the case for evaluation utterances (OF = 1711, EF = 1581.34, AR = 10.55 for regulating the project; OF = 49, EF = 163.51, AR = -10.18 for regulating the meeting). Monitoring utterances, however, showed the opposite result, with relatively fewer utterances directed at the project (OF = 2001, EF = 2574.90, AR = -38.80) and the organization of the collaboration (OF = 36, EF = 58.87, AR = -3.46), and relatively more utterances directed at the meeting (OF = 863, EF = 266.24, AR = 44.09). In Table 11, the combination of directions with activities with phases of regulation is illustrated with examples.

Component 4: Type of Interaction

The original categories developed by Molenaar (2011) to code the type of interaction did not adequately fit the context of this study. We could not find evidence of a meaningful sharing category, as in this setting team members were observed either to accept a regulation activity by replying with a cognitive activity or to engage in each other's regulation efforts. Instead, we used the following three categories of regulatory activities: *ignoring* (when the group members do not relate to or engage in another group member's regulation activity), *accepting* (when the group members engage in a regulation activity by replying with a cognitive activity that confirms, repeats or carries out the regulation activity without changing it), and *engaging* (when group members relate or engage in each other's regulatory activities by further specifying, adapting, or clarifying the previous regulation activity). Because these codes always indicate a response to a previous regulatory activity, a fourth type of interaction, *initiating* (when a team member introduces a new topic with a regulation activity), was added. In Fig. 3 a decision tree is depicted illustrating the operationalization of the four types of interaction.

In Tables 12 and 13, two examples of episodes are displayed, illustrating the use of the interaction type codes. Table 12 shows a conversation during a Stand-up meeting. John initiates a new episode by introducing the topic of the content of the task (story) they are working on (line 1). Thomas engages in the conversation by providing

Table 9 Definitions of codes for step 3, examples, and frequencies

Codes	Definition	Examples	Frequency
Project organization	Regulatory activities directed toward the content of the project	"There were few disturbances while there were a lot of changes this Sprint." "I also started working on the first task for this Sprint."	10,629
Meeting organization	Regulation directed toward the practical organization and logistics of the meeting	"We need to do two things this meeting; complete the planning and discuss the absenteeism"' "I think it's wiser to discuss this after the meeting."	1099
Collaboration organization	Regulatory activities directed toward the practical organization and logistics of the collaboration process outside the meeting	"When are you all going on holiday?" "I am going to change the order of the meetings next week."	243

Table 10 Crosstab of phases of regulation by focus of activity, including observed frequencies, expected frequencies and adjusted residuals

	Project	Meeting	Organization	Total
Planning				
Observed frequency	6917	187	186	7290
Expected frequency	6472.76	669.26	147.98	7290
%	94.88	2.57	2.55	100%
Adjusted residual	26.37[a]	-31.28[a]	5.05[a]	
Monitoring				
Observed frequency	2001	863	36	2900
Expected frequency	2574.90	266.24	58.87	2900
%	69	29.76	1.24	100%
Adjusted residual	-38.80[a]	44.09[a]	-3.46[a]	
Evaluation				
Observed frequency	1711	49	21	1781
Expected frequency	1581.34	163.51	36.15	1781
%	96.07	2.75	1.18	100%
Adjusted residual	10.55[a]	-10.18[a]	-2.76	
Total				
Observed frequency	10,629	1099	243	11,971
Expected frequency	10,629	1099	243	11,971

[a]Significant deviation of the observed frequency from the expected frequency

the specific details of what he is working on (lines 2–3). Andrea accepts the regulatory activities of her team members by confirming the allocation of tasks proposed by John (lines 6 and 8).

Table 13 shows an episode from a Retrospective meeting in which the team discussed what could be improved during the next Sprint. First, Rachel stresses her concern about how they handled the planning of their tasks (lines 1–2 and 4). When Charles tries to engage in this concern by asking for specifications (line 5), Rachel seems to have lost her interest in the topic and ignores Charles's question by saying that she actually does not care (line 6). Later in the episode, Luke proposes a possible solution for their problem (line 7), in which Rachel and Tom engage by further specifying and clarifying the details of the solution (lines 8–12). Then Peter attempts to clarify something (lines 14–15) and Rachel ignores his attempt by interrupting him (lines 16–18).

Of the 22,786 utterances, 969 (4.25%) were initiating, 29 (0.13%) were ignoring, 1588 (7%) were accepting and 10,962 (48.11%) were engaging. The rest of the utterances were knowledge co-construction or off-topic utterances that did not receive an interaction type code.

Table 11 Examples of regulation activities as related to focus of activities

	Project	Meeting	Organization
Planning	"I will have to find something to do next, because the whiteboard h tasks is empty." "You have to check if there's one task from Anne or Cornelius that you can test."	"Bernard, it's your turn now." "We need to do two things during this meeting: complete the planning and discuss the absenteeism."	"Later today, we will have the Sprint planning meeting." "Maybe we can plan an extra meeting for that?" "I was wondering, when will you all go on holiday?" "Oh, my wife needs to be away this afternoon, so I will work at home from 10 a.m. till 12 p.m"
Monitoring	"Last Friday I was busy working on support issues." "I already saw that the ping doesn't work, but the story isn't finished yet."	"So far, we only have one evaluation point with a direct action point linked to it."	"I'm only missing some of the yellow cards. Now it seems like we are very far along, but I think those are still missing." "Why are you actually the person deciding who will talk when?"
Evaluation	"I'm satisfied with the way we fixed the URL's, we have worked hard." "I liked it that we had time for technical stories."	"In my opinion, the last meeting was very, very long." "This has been a very useful meeting."	"So you really prefer to see a burn-down chart during the Sprint?"

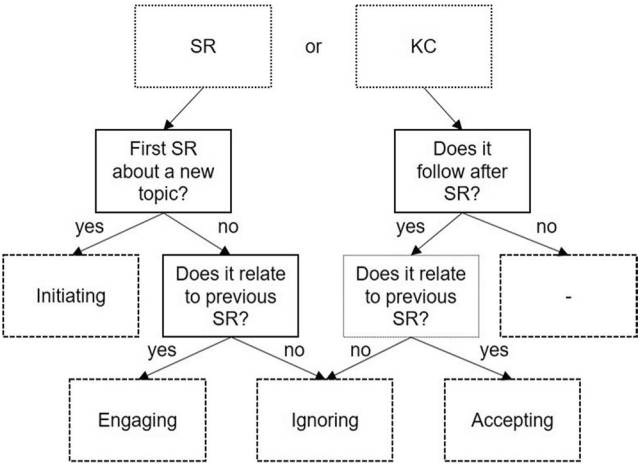

Fig. 3 Interaction analysis decision tree

Social Regulation During Action and Transition Phases

Based on the observed frequencies of the different team reflexivity activities per meeting type, a graph was created showing the percentages of the activities across the transition and action phase (Fig. 4).

Next, investigating the nature of team reflexivity during action and transition phases, chi square analyses were carried out, yielding a significant relation [$\chi^2(9) = 8343.08$, $p < 0.001$ see Table 14], with a moderate effect size (Cramer's $V = 0.36$) (Cohen, 1988). Post-hoc analyses using Bonferroni adjusted alpha levels of 0.0031 and the corresponding z critical value of -2.96 showed that knowledge co-construction occurred relatively less frequently during the transition phase meetings (Planning meeting: OF = 2293, EF = 2737.73, AR = -13.49; Retrospective meeting: OF = 1790, EF = 2163.16, AR = -12.21), and the Stand-ups during the action phase (OF = 1748, EF = 1993.50, AR = -8.27). During Refinement sessions in the action phase, however, knowledge co-construction occurred relatively more often (OF = 3471, EF = 2407.60, AR = 33.56). Planning occurred relatively more often during Planning meetings (OF = 3283, EF = 2145.57, AR = 36.05) than in the other types of meetings. Monitoring occurred relatively more often in Stand-up meetings during the action phase (OF = 1561, EF = 621.50, AR = 45.75) and relatively less during the other three meeting types. Evaluation occurred relatively more often during Retrospectives in the transition phase (OF = 1672, EF = 414.17, AR = 73.70), while evaluation rarely occurred in the other three types of meetings.

Table 12 Example of an episode with initiating, engaging and accepting interactions

Team member		Interaction type	Utterances
1	John	Initiating	Let's go to the content of the story, you were busy writing the LTC?
2 3	Thomas	Engaging	Yes, I began with that and I will continue with it. Furthermore, controlling actuality metadata. I also finished LTC's for manual testing, so that's ready too
4 5	John	Engaging	Right. LTC review developer, controlling test reports… Yes, those are standard tasks. Could you do the LTC review?
6	Andrea	Accepting	That's okay
7	John	Engaging	Could you also update the user case?
8	Andrea	Accepting	Yes, I will
9 10	John	Engaging	Good, I have the utmost faith. Because than I will do that for the other story and then we can finish both

Table 13 Example of an episode with initiating, accepting, engaging and ignoring interaction types

Team member		Interaction type	Utterances
1 2	Rachel	Initiating	Okay, next… The stories. I think that we… I suggest that we plan a little bit more points anyway for this Sprint
3	Charles	Accepting	Yes, that seems good to me
4	Rachel	Engaging	I think, yeah, structurally, you see that we are handling it wrong
5	Charles	Engaging	How many points did we finally estimate?
6	Rachel	Ignoring	Oh, well, I don't really care
7	Luke	Engaging	Or you could define a reference story here for Issue X
8 9 10	Rachel	Engaging	Yes, that's also a possibility. But then you have to deal with another range. Or, at least, because above the 13 points, which we poker a lot, we even play 20 often, you have 40 and 100. The accuracy than becomes…
11 12	Tom	Engaging	But he said we should define another reference story. So, not to increase the points, but to define another reference story for Issue X
13	Luke	Engaging	That's what you did
14 15	Peter	Engaging	Noooo… What you actually propose is, so to say, every error we have on estimating…
16 17 18	Rachel	Ignoring	We just have an Issue X velocity and an Issue Y velocity, you could say. So, we just poker on it, adjust the velocity and make a more accurate estimation
19	Charles	Accepting	That would be the simplest solution

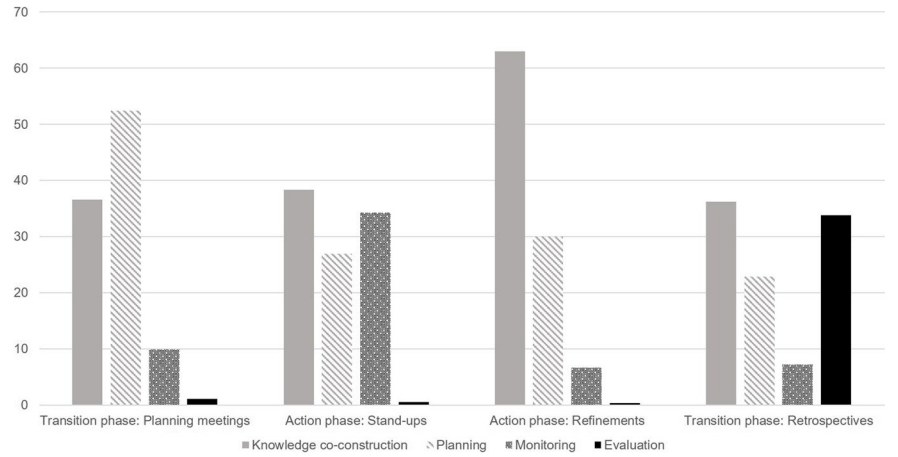

Fig. 4 Distribution of team reflexivity over phases

Table 14 Crosstab of types of meeting by knowledge co-construction and regulation activities, including observed frequencies, expected frequencies and adjusted residuals

	Transition: Planning meeting	Action: Stand-up	Action: Refinement	Transition: Retrospective	Total
Knowledge co-construction					
Observed frequency	2293	1748	3471	1790	9302
Expected frequency	2737.73	1993.50	2407.60	2163.16	9302
% per meeting type	36.62	38.34	63.04	36.18	
Adjusted residual	-13.49[a]	-8.27[a]	33.56[a]	-12.21[a]	
Planning					
Observed frequency	3283	1226	1651	1130	7290
Expected frequency	2145.57	1562.31	1886.84	1695.28	7290
% per meeting type	52.44	26.89	29.99	22.84	
Adjusted residual	36.05[a]	-11.84[a]	-7.78[a]	-15.11[a]	
Monitoring					
Observed frequency	618	1561	366	355	2900
Expected frequency	853.52	621.50	750.59	674.39	2900
% per meeting type	9.87	34.24	6.65	7.18	
Adjusted residual	-10.33[a]	45.75[a]	-17.55[a]	-15.11[a]	
Evaluation					
Observed frequency	67	24	18	1672	1781
Expected frequency	524.18	381.68	460.97	414.17	1781
% per meeting type	1.07	0.53	0.33	33.80	
Adjusted residual	-24.83[a]	-21.58[a]	-25.04[a]	73.70[a]	
Total					
Observed frequency	6261	4559	5506	4947	212,273
Expected frequency	6261	4559	5506	4947	212,273

[a]Significant deviation of the observed frequency from the expected frequency

Discussion

In this study, we explored the nature of team reflexivity when studied during both teams' action and transition phases. In response to the call for more fine-grained analyses of team reflexivity in the workplace (Konradt et al., 2016), we developed an analytical framework covering four components of social regulation to investigate the nature of team reflexivity. The developed framework can be used to perform a holistic and systematic analysis of the relevant components of team reflexivity in both the action and transition phase. The first added value of the proposed framework is its potential to explicitly distinguish reflexivity activities from knowledge co-construction, addressing a gap in previous research and enabling the investigation of the theorized interrelatedness of the two levels of activities (see e.g., Konradt et al., 2016; Schippers et al., 2018) and their relation to team performance in future research. Second, addressing the call for a more fine-grained analysis of team reflexivity (Konradt et al., 2016), the analytical framework is able to cover the multidimensionality of the construct as it focusses on planning, monitoring and evaluation concertedly. Third, in response to the (still limited) literature suggesting that revealing the focus of regulatory activities (i.e., what element of teamwork is being addressed) might provide important details on the relation between team reflexivity and performance (see e.g., Fisher, 2014), the framework is able to distinguish between project, meeting and organization focused reflexivity activities. Regulation of the meeting was a newly added focus of regulation compared to previous work on student teams. This is probably caused by the fact that the Scrum teams do not work on their task, while discussing it. Therefore, the meeting became an entity by itself and also an object of their joint regulation. We expect that this category will disappear when the framework is applied to action teams in the workplace. Contrary to the work of Grau and Whitebread (2012), we did not find evidence of regulation of socio-emotional aspects, and therefore did not include this as a separate category in our framework. An explanation could be that team members mostly regulate their emotions internally without explicating this in their joint verbal communication. In future research we might want to include non-verbal signs of regulation of socio-emotional regulation, such as postures and facial expressions as we know from research on student teams that even though the occurrence is relatively rare, regulation of emotion is crucial in challenging situations (Järvenoja et al., 2019). Finally, with the analytical framework, we were able to examine different interaction types, showing whether and to what extent regulatory activities were accepted by others and elaborated upon. It was not possible to distinguish both sharing and co-construction as identified by Molenaar (2011) but merged this into one category (engaging). This was partly for the same reason as mentioned above: teams were not able to directly apply the regulatory activities and see the outcomes; they had to discuss them until they thought they had arrived at a good idea on how to progress, and would continue this work after the meeting was over. We found a high frequency for this engaging category, showing that the team member were highly involved in the shared coordination and evaluation of

their work. This is probably related to the agility of the teams and that all team members jointly shared authority for decisions (see Dybå et al., 2014). In addition, as the work teams in our study were engaged in many sub-tasks of a large project, the regulatory activities were not a continuous flow of regulating one task; many sub-tasks were discussed. To highlight this type of regulation activity, an *initiating* category was added to highlight the start of a new topic.

Concluding, integrating the insights of research from student learning settings focused on social regulation activities and the workplace setting, we were able to extend the team reflexivity perspective with an analytical framework able to cover the full cycle of reflexive behaviors, acknowledging the complexity of these team processes.

The Nature of Team Reflexivity in Self-managing Teams

Examining the nature of team reflexivity in the agile workplace with our framework revealed that more than half of the conversations during team meetings concerned regulation-related utterances, indicating that team members spend a lot of time and effort explicitly regulating their interpersonal behaviors during their joint meetings. At the same time, a considerable amount of utterances was directed at the content of the task. Teams needed to engage in content related discussions quite frequently to develop an accurate shared understanding about the task in order to coordinate their work and reach their goals. As suggested in previous research, cognitive activities might play an important role in explaining the relation between team reflexivity and team performance: team reflexivity creates the opportunity to explicitly create a joint understanding of the tasks and thereby possibly affecting performance (Kneisel, 2020). Further studies are needed to find out more about the interrelatedness and optimal balance between the cognitive and regulation activities and its relation to performance.

Zooming in on the *regulation activities*, our results showed that these self-managing teams spent most of their time planning. This might be explained by the fact that group work activities in the agile workplace are mostly ill-structured, requiring the use of multiple strategies and involving multiple possible solution paths (Dybå et al., 2014; Malmberg et al., 2014; Tynjälä, 2008). Combining this with the *foci of the regulation activities*, we saw that the dominance of planning was present when the content (project) and the organization of the work was regulated, but not when the regulation was focused on the meeting: in these cases, we saw a high dominance of monitoring. This was often done in relation to time and sometimes to the monitoring of decision points. However, without explicit procedural behaviors such as planning (e.g., setting the agenda and suggestions about topics to discuss next) and evaluation of the meetings, teams might end up in dysfunctional interactions, for example losing their train of thought (Lehmann-Willenbrock et al., 2013; Sonnentag, 2001). At the same time, the occurrence of evaluation statements was overall very rare, also with respect to the content of their work. This is in line with the findings of a study in the workplace setting by Stray et al. (2011) that many teams in the workplace spend little time on evaluating their work, struggle to convert points

for improvement into actual action and fail to discuss obvious problems. Apparently, even in the structured Scrum setting in which time is especially devoted to reflection (retrospective meeting), teams hardly engaged in evaluation activities. Previous theorizing about the lack of evaluation in teams suggests that teams often are focused more on their short-term results than on learning and improving their performance long term (Faller et al., 2020; Gabelica et al., 2014). This might especially be the case in our study due to the pressure to finish on time, characteristic for the agile way of working (Dybå et al., 2014), possibly resulting in the idea that time should rather be spend on planning and monitoring the present task work than on reflecting on past experiences.

With respect to the *interaction types*, we saw a high dominance of engagement, showing that team members engaged with each other's regulatory input by discussing, revising and elaborating it. Although we only used one category to describe the engagement of team members with each other's regulatory activities, we did see differences in the level of engagement: this could vary from a simple elaboration to an expansive discussion. These differences would be very interesting to pick up in further research and arrive at a more fine-grained analysis of the levels or types of engagement, such as the level of depth of the reflexivity interaction (Otte et al., 2018). We also attempted to do this in our study, but we learned that in order to make meaningful distinctions a very thorough understanding is needed of the importance of each contribution (see e.g., De Backer et al., 2020). To carry out this type of analysis, expert knowledge is needed on the topic of the discussion, which is difficult to get access to in highly specialized ICT teams. A remarkable result was that the interaction type *ignoring* rarely occurred, while in student teams, about one-fifth of the regulatory activities were ignored (Molenaar, 2011). This might be related to the age of the participants, as it might be more difficult for young children both to process their own thoughts and to relate them to what just has been said. In the workplace context, more subtle forms of ignoring might be present, currently not detected by our framework. For example, from previous research we know that during team meetings not all discussions end with an explicit mutual agreement or wrap-up of the conversation (Raes et al., 2017), but sometimes suddenly change topic. When applying the analytical framework in a future study, these types of subtle forms of ignoring might be detected when for example also non-verbal behaviors are included.

Team Reflexivity During Both the Transition and Action Phase

In our study, teams worked according to the Scrum method with the different types of meetings, which closely resembles the team reflexivity cycle and covering both the transition and action phase. They started off with a planning meeting, continuing with both short and longer monitoring sessions and ending with an evaluation meeting. The assumption that the three activities as described above unfold in a cyclical manner is well-grounded in the theoretical model of social regulation, and is also sometimes mentioned in the team reflexivity field (see e.g., Schippers et al., 2018). It involves an iterative process in which people move through the different

activities; however, there is no indication of a strict order to this process, as people can jump between the activities as needed (Greene & Azevedo, 2010). What most models have in common is that the phase of the team's development is assumed to motivate their regulatory activities (Hadwin et al., 2017; Konradt et al., 2016), often resulting in quite rigid prescriptive models that allocate specific type of activities to certain phases: monitoring the progress towards goal attainment is specific for the action phase, whereas evaluation and planning are attributed to the transition phase (Driskell et al., 2018). In our study with experienced Scrum teams, we have seen that the designated regulation activities are indeed relatively more present in the corresponding phase (e.g., more planning and evaluation in the transition phase and monitoring in the action phase, but the vignettes also showed how planning and monitoring activities continuously alternate in the transition phase. Especially in the longer monitoring meetings during the action phase, we saw not only a high dominance of planning activities, but also of cognitive activities to rediscover a shared understanding of their task. This suggests that even though monitoring the progress of their project was the main goal of these refinement sessions, teams spent most of their time adjusting their plans when reflecting on their work.

In the transition phases we saw quite a large difference between the presence of planning and evaluation in planning meeting versus the retrospective meeting. In the retrospective meeting, this was quite balanced, while in the planning meeting, almost no evaluation activities from previous sprints were carried out or recollected. From previous research (Iiskala et al., 2015), we know that the function of regulative activities can be either to continue and facilitate the current direction or to inhibit the continuation of appropriate adaptive behavior. Inherent in the definition of reflexivity is that it concerns metacognitive actions people take in the face of difficulty in order to adaptively respond to challenges and optimize their progress (Hadwin et al., 2017). The explicit goal of Retrospective sessions is to evaluate progress by discussing challenges and difficulties, but also to plan for future improvements based on the evaluation. Considering this cyclical adaptive nature of both team reflexivity and the Scrum structure, this can only have effect when also in Planning meetings evaluations from previous rounds are included. In addition, also evaluation during action could yield relevant effects on performance considering that the timing is more directly related to the actual activities to be performed and therefore could intercept errors in real time (Moreland & McMinn, 2010). However, the relationship between evaluation during the action phase and team performance is not yet clear, and the opposite is being suggested as well. Namely, that engaging in evaluation during action might take away time and resources relevant for the completion of the task at hand as it involves a quite challenging high-order activity, resulting in less optimal performance (Gabelica et al., 2014). Overseeing the results of this study, we expect that the answer to the question on the relation between team reflexivity and team performance is not in the mere presence of certain activities in the different phases, but also on their dynamics and interrelationships. To further our understanding of the sequential aspect of reflexivity, a process-oriented approach is needed and analytical techniques suitable for examining temporal processes need to be adopted (Järvelä & Bannert, 2019; Li et al., 2021; Schippers et al., 2018). In recent years there has been a growing focus on the sequential and temporal aspects of team

reflexivity (Georganta et al., 2021; Kneisel, 2020; Li et al., 2021; Yang et al., 2020) and social regulation (Azevedo, 2014; Bannert et al., 2014; De Backer et al., 2015; Malmberg et al., 2017; Molenaar & Chiu, 2014; Molenaar & Järvelä, 2014; Schoor et al., 2015). However, much remains unclear about how reflexivity activities are interrelated during collaboration (Kolbe & Boos, 2019; Schippers et al., 2018). In future studies, this could be taken into account, for example, by using process mining techniques (see e.g., Bannert et al., 2014; Sobocinski et al., 2017) to uncover how the reflexivity activities team members go through dynamically affect and influence one another.

Limitations and Future Studies

The analytical framework has been developed using data of experienced Scrum teams. Despite the fact that nowadays many organizations are adopting agile management methods relying on self-managing teams (Peeters et al., 2022), the specific characteristics of the IT sector might have resulted in outcomes that are not generalizable to other settings. For example, the agile method allows for reorientation during the process, resulting in high frequencies of planning also in the action phase. Also, we saw high levels of engagement, that might result from the absence of a hierarchical leader. At the same time, we have no reason to believe that the framework itself cannot be applied to other agile or project teams or similar type of teams that have meetings to coordinate and evaluate their work, but frequencies of appearance of the different categories might differ. For example, teams without predefined meetings to regulate their work might engage less jointly in these activities. However, we do expect that adaptation will be needed for the context of action teams where reflection takes place in the heat of the moment (Schmutz et al., 2018). Although evaluation meetings of project teams might be similar to debriefing meetings of action teams, we expect that team reflexivity in the action phase will manifest itself differently: a more uneven distribution of members participating in the reflexive activities in the heat of the moment can be expected as others are engaged in critical actions leaving limited resources to join the reflection, but also as the outcomes of reflection have immediate implications during the action phase, we expect especially more variations in interaction types in action teams (Schmutz et al., 2018). Therefore, further refinement of the framework in future research in other settings is necessary and perhaps domain-specific versions of the framework can be developed.

As described in the method section, the teams under study are self-steering and differed in size and longevity. Beyond the scope of this study, but possibly relevant for future endeavors might be to examine the effect of differences between team characteristics on the manifestation of team reflexivity. Previous research has shown effects of, for example, team familiarity on team communication and adaption to change, (Muskat et al., 2022), the desired balance between the size of a team and the information processing demands in relation to team learning behaviors (Staats et al., 2012; Wiese et al., 2022), and that teams with a formal leader show different (amounts of) team learning behaviors compared to leaderless teams such as the

teams included in the current study (Wiese et al., 2022). Although the number of teams was limited, we know from research on different team processes that variation within teams is often larger than variation between teams (Endedijk et al., 2019). Therefore, observing complete lifespans of six different teams, covering a total of 100 meetings, has provided us with a very comprehensive set of data that allowed us to capture a great deal of variations in team reflexivity.

A final limitation of this study is that we cannot relate the findings to performance measures or make statements about the quality of the activities investigated. This is one of the great challenges of workplace learning research: for project and development teams their performance is difficult to assess, as they deal with outputs that are complex and unique (Hollenbeck et al., 2012). Team reflection and evaluation and its relation to performance have been examined in previous studies in experimental settings (see Faller et al., 2020 for an overview). Results show, for example, a positive relation between the occurrence of team reflection (Kneisel, 2020), high quality reflection (Otte et al., 2018), and performance improvement. Finding good performance measures in a naturalistic workplace setting, however, is incredibly hard, and therefore we see a possible way forward to focus more on the direct in-process outcomes of team reflexivity: for example, to what extent the reflexive contributions were adaptive or maladaptive (Sobocinski et al., 2020) or whether insights based on reflexive activities are indeed acted upon or implemented in subsequent activities (Otte et al., 2018).

Conclusion

In the present study, we adopted a social regulation perspective to develop an analytical framework to study team reflexivity in action and transition moments. We operationalized four relevant components (i.e., regulation and knowledge co-construction; regulation activities; focus of regulation and type of interaction), showing the multidimensionality and depth of this concept, compared to how it is often studied (Schippers et al., 2018). The results suggest that the different aspects of reflexivity are probably more interrelated than previously depicted. With the developed framework, future research could examine the interaction between all relevant processes and how they together relate to the performance and functioning of teams. In addition, by examining both the activities before and after task execution during the transition meetings and the activities during task execution in the action phase meetings, we were able to show that teams engage in different team reflexivity activities depending on the phase they are. In line with Schippers et al. (2018) and Schmutz and Eppich (2017), we contend that different activities might be important in different phases and that when studying the antecedents, targets and outcomes of team reflexivity activities both the transition and action phase should be taken into account in an effort to explain team performance within and across these phases. Furthermore, by providing thick descriptions and concrete details of what applying the framework looked like, we aimed to offer transparency and the possibility of transferability.[1] The present study presented a carefully and precisely described

[1] The authors can be contacted for further support in applying the framework and a training data set.

framework that can be used by others, which is crucial for advancing the knowledge base for our field and its application across domains.

Authors' Contributions The first author (MW), set up the study, collected the data and took the lead in writing the manuscript with input from the second (ME) and third author (BV). ME helped supervise the project and ME and BV assisted MW in reviewing the analyses. All authors discussed the results and contributed to the final manuscript. The author(s) read and approved the final manuscript.

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Availability of Data and Materials The datasets generated and analysed during the current study are not publicly available as they contain information that could compromise research participant privacy and consent, but are available from the corresponding author on reasonable request. The video-observations are in Dutch.

Code availability
Not applicable.

Declarations

Ethics Approval and Consent to Participate The research was approved by the ethics commission of the UT (16145).

Written informed consent was obtained from all individual participants included in the study.

Consent for Publication The participants have consented to the publication of their data and transcribed communication.

Competing Interest The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as potential conflict of interest.

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