Exploring the role of the Facilitator in Initiating Team Learning in Learning Communities

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Author notes

Proudly, I present my master thesis. To summarize the process behind this product, the quote "good learners go in a pit" is applicable. This process has been with ups and downs, but I think both elements are necessary to create a good product and for an effective learning experience. And what an experience it has been. I learned a lot about conducting research, the topic at hand, but above all about myself.

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I hope you will enjoy reading this thesis!

Abstract

Innovations in the energy sector caused a need for different knowledge and skills from installation companies and their employees. To meet the new requirements, the use of Learning Communities (LCs) is proposed. In LCs, up to ten participants team up to learn and innovate, supported by a facilitator. For a team to construct knowledge and skills together, team learning processes are essential. Although it can be expected that the facilitator initiates team learning processes in LCs, it has not been studied yet, as literature on LCs is scarce. It is also not known how the more complex team learning processes could be initiated. This research explores if and with what behaviour the facilitator initiates team learning processes, as well as if the team learning initiation changes over time. The study is an exploratory case study, analyzing two LCs using observational data. The results indicated firstly that the facilitator is initiating team learning more than the other members. Secondly, questions of the facilitator could initiate more complex team learning processes. In addition, the member initiation changed a lot per meeting, which suggested that other members initiate team learning when a role or task is assigned. However, taking the exploratory nature and the use of only two cases into account, future research should build further on these indications, either to confirm or reject these. This will contribute to existing -limited- research on LCs. Moreover, provide input for the design and delivery of the LCs, especially regarding the use of the facilitator.

Keywords: Learning communities, team learning, team learning initiation, facilitator behaviour, energy sector

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Introduction

The Dutch government is pursuing policies aimed at reducing greenhouse gas emissions, which leads to a need for change in installation technology (Vermeulen et al., 2018). These innovations require a change from the installation companies and the employees in the sector, as the existing knowledge and skills in these companies are outdated for the energy transition (Topsectoren, 2019). The installer will need different knowledge and skills, will create customized solutions, and will have a different role than before (Vermeulen et al., 2018).

Topsectoren (2019) proposes a Learning Community (LC) as a means to meet the new requirements. An LC is an interprofessional team in which employees of an installation company and higher education institutes come together. An interprofessional team consists of employees with different professions and from different departments. Together they try to solve challenges in practice, related to the energy transition (Corporaal et al., 2020). The concept of an LC originated from practice (Topsectoren, 2019). Therefore, it does not have a substantial scientific base yet (Hubers et al., 2021); the design principles and learning processes are still in the pilot phase (Van Rees et al., 2022).

One of the core elements of an LC is team learning (Corporaal et al., 2020), as it is recognized as one of the most effective team processes (Mathieu et al., 2008). Team learning consists of several processes according to the integrative model of Decuyper et al. (2010). Firstly, it consists of sharing of knowledge, skills, or attitudes within a team. Moreover, the processes that take team learning to a more complex level, are the processes that integrate knowledge, skills, and attitudes of multiple team members into a shared mental model (Decuyper et al., 2010).

An external facilitator is assigned to actively guide and stimulate the learning processes of the members (Hubers et al., 2021), as the facilitator can help to create and sustain a safe and effective learning environment (Ortquist-Ahrens & Torosyan, 2009). Therefore, it could be expected that the facilitator initiates team learning in the LCs. However, team learning models are lacking insights into the role of the facilitator, especially in the context of an LC. It is to our best knowledge not researched if the facilitator could initiate team learning in the context of an LC. Therefore, studying who initiates team learning is the first research question (RQ) of this research.

The second RQ aims to explore how the facilitator could initiate team learning within an LC. To examine how the facilitator initiates team learning, the facilitator's behaviour

should be analysed. This allows us to study what facilitator's behaviour might initiate the different team learning processes. More specifically, this could examine what behaviour could initiate the more complex processes of team learning, that go beyond just sharing.

In addition, in the literature two perspectives on a possible change over time regarding team learning initiation could be identified. The first perspective focuses on empowering the members to find and use their potential (Bentley, 1994; Macneil, 2001). These authors expect that members become more responsible for their learning over time, and thus that the other members initiate more team learning over time. While the second perspective stresses the managing role of the facilitator of all the group processes (Kolb et al., 2008; Schwarz, 2005; Shaw et al., 2010). This second perspective expects no change in the facilitator's behaviour over time, but the same behaviour is expected every meeting. The third RQ will explore this change over time in the initiation of team learning and the facilitator's behaviour.

This exploratory research aims to answer these three RQs using two pilot LCs, also used by the study of Van Rees et al. (2022). The answers to these questions will contribute to the currently limited research on LCs, and specifically on the role of the facilitator in the LCs. As Hubers et al. (2021) and Van Rees et al. (2022) suggested, increasing the research on LCs is required. These new insights can provide indications for further (re)design and delivery of upcoming LCs to increase their impact. In addition, the suggestions of this study can also function as the first step in creating training for the facilitators on how to facilitate an LC as suggested by Van Rees et al. (2022).

Theoretical framework

Learning communities

Within an LC a combination of learning, working, and innovating takes place. An LC has an interprofessional character since multiple professions come together to learn and innovate (Topsectoren, 2019). Interprofessional communities differ from Professional Learning Communities (PLCs) or Communities of Practices (CoPs). A PLC involves people of the same profession who reflect on their practice together, which is often seen in the educational sector (Stoll et al., 2006). And a CoP consists of people with the same passion, concern or practice (Wenger, 2011). Hence, PLCs and CoPs consist of people with the same profession or practice and do not have that interprofessional character that an LC has. When the term LC is used in the current study, it thus refers to an interprofessional LC. LCs, as opposed to CoPs and PLCs, are not extensively described in current literature (Hubers et al.,

2021). Hubers et al. (2021), Topsectoren (2019) and Van Rees et al. (2022) are one of the few to describe an LC. An interprofessional LC could be seen as "public private partnerships in which learning, working and innovating come together in hybrid learning environments" (Van Rees et al., 2022, p. 1, based on Dingyloudi & Strijbos 2020; Topsectoren, 2019).

As the research on these kinds of LCs is limited Van Rees et al. (2022) identified design principles for LCs in the energy transition based on a literature study. Three main pillars were identified. At first, participants need to feel safe to participate in the shared process of learning. This means that participants need to feel like they can make mistakes within the LC and within their company. Secondly, the topic of the LC needs to align with the daily work of the participants to stimulate active participation. And lastly, a facilitator should guide the learning process, so that self-directed learning is stimulated within the participants (Van Rees et al., 2022).

Team learning

An LC can be considered a team, following Salas et al. (1992) with their definition of teams: "teams are a collection of individuals who are interdependently working to achieve a shared goal" (in Wiese & Burke, 2019, p. 1). The performance of a team can be improved by team learning (Mathieu et al., 2008) and is one of the key elements of an LC (Corporaal et al., 2020). The research on team learning is extensively increased since Senge (1990) emphasised the substantial influence of team learning. The increase in team learning research also caused a babel like confusion (Edmondson et al., 2007), resulting in 30 different definitions found in a literature search (Decuyper et al., 2010).

There is a distinction in the literature between considering team learning as a process or as an outcome (Decuyper et al., 2010). An example of considering team learning as a process is: "learning behaviour is defined as processes of construction and co-construction of meaning, with constructive conflict as a vehicle to enhance (co-)construction. This learning behaviour gives rise to mutually shared cognition, leading to higher team effectiveness" (Van den Bossche et al., 2006, p. 502). Whereas an example of considering team learning as an outcome is: "a change in the group's repertoire of potential behaviour*"* (Wilson et al., 2007, p. 1034). For the current study, the context of an LC should be considered. Within LCs learning is regarded as a central process that the facilitator should actively support (Hubers et al., 2021). Team learning is not considered an outcome of the LCs.

Following the notion that team learning is considered a process, this research builds on the team learning model of Decuyper et al. (2010) as it also considers team learning as a

process. Within interdisciplinary articles, they found 486 different variables that are related to or important for team learning, which are integrated into one comprehensive model. The model is extensive and describes the concept of team learning with Basic Team Learning Processes (BTLPs) and Facilitating Team Learning Processes (FTLPs). The distinction between the BTLPs and FTLPs can be derived from the following citation: "where the basic process variables are responsible for the power of team learning, the facilitating variables give context and focus to team learning, influencing both its efficiency and effectiveness" (Decuyper et al., 2010, p. 117). This study is interested in the BTLPs as the BTLPs describe what happens teams learn (Decuyper et al., 2010), which can be observed in the interaction between members (Raes, Boon, et al., 2015).

Basic team learning processes (BTLPs)

Decuyper et al. (2010) described three BTLPs, which are based on a combination of the studies of Van den Bossche et al. (2006) and Wilson et al. (2007). The BTLPs describe which actions happen when teams learn and what change will be generated. These BTLPs are *sharing*, *co-construction* and *constructive conflict*. The first process -sharing- is mostly based on Wilson et al. (2007) and is used in other terms by Van den Bossche et al. (2006) as construction (Decuyper et al., 2010). Wilson et al. (2007) defined sharing as: "the process by which new knowledge, routines, or behaviour becomes distributed among group members and members understand that others in the group possess that learning" (p. 1044). But Decuyper et al. (2010) adjusted this definition based on the integration of more literature concerning the concept sharing or similar concepts. They stated that knowledge, routines or behaviour do not have to be newly created, but rather be unshared in the team yet.

Sharing can be seen as the least complex team learning process. Because besides just sharing knowledge, routines or behaviour, team learning is also about creating a shared mental model (Decuyper et al., 2010). A shared mental model is considered by Decuyper et al. (2010) as one of the most important input variables of team learning. And sharing seems not to contribute to a shared mental model. The other two BTLPs seem to contribute to creating a shared mental model, which takes team learning to a more complex level. The distinction between these two BTLPs is made based on varying types of interaction. Co-construction builds on sharing but takes it a step further. In addition to shared knowledge, a new meaning is also created together. Constructive conflict, on the other hand, is about diversity in team interaction. Decuyper et al. (2010) adopt the definition of Van den Bossche et al. (2006): "negotiation of the differences in interpretation among team members by

arguments and clarifications" (p. 496). Constructive conflict is seen as the most vital process for team learning and also the most complex process (Van den Bossche et al., 2006).

Facilitator initiating team learning

Team learning does not display automatically in a team (Koeslag-Kreunen et al., 2018). There are multiple variables that could influence team learning, of which team leader's behaviour is one variable (Decuyper et al., 2010; Koeslag-Kreunen et al., 2018). The influence of a team leader's behaviour is often researched (see for example Bucic et al., 2010; Edmondson, 2003; Raes et al., 2013) and summarized by the meta-analysis of Koeslag-Kreunen et al. (2018). This study showed that 18% of the variance in team learning can be explained by the behaviour of the team leader.

However, in an LC there is no team leader assigned. An external facilitator is assigned to actively stimulate the learning processes of the members (Hubers et al., 2021), while being part of the team (Kolb, 2011). It seems that the behaviour of the facilitator partly overlaps with the behaviour of a team leader, as the facilitator is seen as a mix between a leader, coach, instructor and teacher (Kolb, 2011; Macneil, 2001; van Maurik, 1994). The way a facilitator is described in the literature differs. In short, the facilitator can "help groups do better" (Schuman, 2005, p. xi), and is responsible for managing the group process and dynamics (Kolb et al., 2008). But a more in-depth and unambiguous definition is not (yet) widely adopted.

When the reasons for assigning a facilitator are dissected, the role of a facilitator becomes clearer. Several reasons for appointing a facilitator have been found in the literature. The found studies describing the role of the facilitator are conducted in other fields and contexts such as PLCs (Binkhorst et al., 2015; Margalef & Pareja Roblin, 2016; Ortquist-Ahrens & Torosyan, 2009; van der Want & Meirink, 2020) or work teams (Bentley, 1994; Kolb et al., 2008; Macneil, 2001; Schuman, 2005; Schwarz, 2005), which do not have the same context as an LC. But these studies are nonetheless used, in order to get indications of the possible role of the facilitator. Firstly, a facilitator can ease the participants into a new and unnatural setting (Ortquist-Ahrens & Torosyan, 2009). Second, a facilitator can help guide participants through the learning process, as participants may have difficulty understanding and expressing what learning entails (Van Rees et al., 2022). On top of this, the facilitator can help to create and sustain a safe and effective learning environment (Ortquist-Ahrens & Torosyan, 2009). Lastly, assigning an external facilitator, in contrast to an internal facilitator, can be beneficial for reflecting and learning together (Goodyear & Casey, 2015).

To summarize, the reasons for appointing an external facilitator are multifaceted. And they all indicate that the facilitator could initiate team learning. However, there are also indications that the other members should initiate team learning. In the description of an LC, it emerges that the learning processes within an LC should be self-regulated to some extent (Corporaal et al., 2020). This means that members should take charge of their learning. If members take charge of their learning, it can be expected that the members, rather than the facilitator, initiate the BTLPs. Thus, it is not known who initiates BTLPs, and it should be investigated whether the facilitator or the other members initiate BTLPs in an LC.

Analysing the initiation of BTLPs

To study if the facilitator or the other members initiates team learning, it needs to be clear how the initiation of the BTLP can be analysed. The BTLPs consist of communicative behaviour (Decuyper et al., 2010), and consist of multiple utterances on the same topic, called an episode (Raes, Boon, et al., 2015). For analysing how such a team learning episode (TLE) has been initiated, the first communication unit could be analysed. This can also indicate which BTLPs are initiated by the facilitator and which BTLPs are initiated by the other members.

Sequentially, it should also be tested *how* the facilitator initiates BTLPs. This is important because, as mentioned earlier, BTLPs differ in the extent of how complex the team learning process is. It could be beneficial to study which facilitator's behaviour could initiate the more complex team learning processes and thus how the facilitator might initiate the team to move beyond sharing. To test how the facilitator initiates the BTLPs, the behaviour of the facilitator demonstrated when initiating the TLE needs to be analysed further. For this, the first communication unit needs to be analysed further. Communication units can be analysed through the *Interaction Process Analysis* of Bales (1950). According to Bernard (2006), this method allows an analysis of every act of communication, despite the topic of the meeting, type of interaction or cultural differences. This thus allows us to explore the initiation of the BTLPs.

In the Interaction Process Analysis of analysis Bales (1950) described six socio-emotional areas (shows solidarity, shows tension release, agrees, disagrees, shows tension, shows antagonism) and six task areas (give suggestion, give opinion, give orientation, ask suggestion, ask opinion, ask orientation). Even though, some could state this analysis is outdated, recent papers still use this method in the field of classroom meetings (Koivusaari, 1999), analyzing teachers (Malinauskas & Saulius, 2020), team meetings (Nam et al., 2009)

and committee meetings (Pagliari & Grimshaw, 2002). Hence, this analysis could allow analyzing the first communication unit and therewith analyzing which facilitator's behaviour initiates TLE, and more specifically the different BTLPs.

Two perspectives on change over time

Within the literature, there also seem to be indications that the initiation of team learning might change over time in an LC. Within the indication, there could be two different perspectives identified. The first perspective stresses the responsibility of the learner for their development and process. This means the individual's willingness to participate in a learning process is not only the responsibility of the facilitator (Macneil, 2001), as "people cannot be developed by others" (Bentley, 1994, p. 11). The change over time that is described by this perspective indicates that the facilitator empowers the other members "to take control and responsibility for their own efforts and achievements" (Bentley, 1994, p. 11). In other words, there should be more member initiation and less facilitator initiation over time, as the members take over the responsibility for the learning processes.

The second perspective emphasises the position and role of the facilitator in the group. This can be derived from the following definition of a facilitator by (Kolb et al., 2008): "a person who remains neutral in the actual decision(s) of the group but who assumes the responsibility for managing the group's process while it is attempting to solve a problem or reach a decision or perform a task" (p. 123). This approach focuses more on facilitating the team as a whole and the corresponding tasks for the facilitator such as managing the group's discussions to achieve the desired goals (Schwarz, 2005). Following this line of reasoning, the second perspective expects no linear change over time, as Shaw et al. (2010) stated that "facilitators are prompted to act in the moment to respond to group conflict as it surfaces" (p. 10). It is stated that the facilitator's behaviour does not follow phases of group development, but rather adjusts to the needs of the group per meeting. And every meeting the participants need the same facilitation in the form of encouragement, conflict management or guidance in steps toward success (Shaw et al., 2010). Thus, the expectation arises that the facilitator is showing the same behaviour every meeting without changing over time.

To summarize, these two perspectives differ in their understanding of the change in the initiation of team learning over time. The first perspective expects that who initiates team learning changes over time, while the second perspective expects no change in the facilitator's behaviour as it should be the same per meeting. When comparing the two perspectives to the design of the LCs, both perspectives can be recognized in the key elements of LCs described

by Corporaal et al. (2020). Because they state that the support of the facilitator can vary from time to time but should diminish over time, as the members become more self-regulated in their learning process. This indicates that the facilitator and member's initiation should change over time, aligning with perspective one. However, Corporaal et al. (2020) also describe that the facilitator should provide support when the team needs their support, which can also be still in the end. This indicates that the facilitator's behaviour might not change over time but is the same per meeting based on the needs of the LC, aligning with perspective two. To analyse which perspective(s) could be observed in the LCs, both perspectives need to be examined by analysing the change over time as well as the differences per meeting.

This study

Aim of this study

Based on the theoretical framework three gaps in the literature can be identified. The first gap consists of not knowing if the facilitator or the other members initiate the BTLPs in LCs. It can be expected that the facilitator initiates these BTLPs as they are assigned to actively support the learning processes, but it can also be expected that the members initiate TLE as self-regulated learning is also a key element of the LC. As this is not researched yet, this leads to the first RQ:

RQ1: To what extent does the facilitator (versus the members themselves) initiate team learning processes in an LC?

Secondly, following the notion that the facilitator initiates team learning, the second gap in the literature consists of not knowing how the facilitator initiates team learning. For analysing how the facilitator initiates the BTLPs, their behaviour should be analysed. These outcomes might indicate what facilitator's behaviour can initiate team learning, as well as what behaviour can initiate the specific BTLP. Consequentially this will show whether there is a specific behaviour that initiates the more complex team learning processes. This leads to the second RQ:

RQ2: Which facilitator's behaviour initiates team learning processes in an LC?

Lastly, the literature provides two different perspectives on the change in the initiation of team learning over time. The first perspective indicates a change over time in the initiation of the members, while the second perspective indicates no change over time in the

facilitator's behaviour but the same behaviour every meeting. So, both perspectives differ in their understanding of the change in team learning initiation over time. And it is not known which perspectives can be seen in LCs as both perspectives seem to be key elements of LCs (Corporaal et al., 2020). So, it could be tested how the initiation of BTLPs and how the facilitator's behaviour change over time. This leads to the last RQ with two sub-questions.

RQ3: Does the way of initiating team learning processes change over time in an LC?

RQ3.1: Does the ratio between who is initiating TLE change over time?

RQ 3.2 Does the facilitator's behaviour initiating TLE change over time?

Context of this study

For this study two pilot LCs of the project Hit the Gas! are used, corresponding with a part of the dataset used in Van Rees et al. (2022). Hit the Gas! sets up LCs in collaboration with installation companies and higher educational institutes in the Netherlands (Corporaal et al., 2020). The companies are selected based on the following criteria: small and medium-sized enterprises, (< 500 employees), located in the Eastern part of the Netherlands, active with energy transition-related innovations (Corporaal et al., 2020).

Method

Research design

This research is an exploratory case study, using two LCs as two cases. Qualitative and quantitative approaches are both used. The qualitative approach consisted firstly of identifying the team learning processes and the facilitator's behaviour with the help of coding schemes. The codes are further analysed using a quantitative approach. And next the results are interpreted with textual using a qualitative approach again. The LCs are analysed via recordings because measuring team learning using observational data is a more suitable choice than the use of questionnaires or interviews (Raes, Boon, et al., 2015). Also, observations provide a realistic view of the real-life setting, which can give insight into the complexity and dynamic of teamwork happening in the now and here instead of the perception of it after the meeting (Frey, 1994).

Participants and context

Two pilot LCs of the study of Van Rees et al. (2022) are used. These LCs, as well as the installation companies and the participants are purposefully selected because purposive sampling can ensure that the participants are fitting the research context (Coyne, 1997). Fitting the research context is important for researching the LCs as the criteria and requirements of an LC should be met.

Both LCs were conducted at different installation companies, called company A and B, and respectively LC A and LC B. Due to COVID-19 measurements at the time of executing these LCs, the LC A was held online via MS Teams. LC B could be in-person and was in a meeting room at the company on-site. LC A consisted of 8 meetings, and LC B consisted of 10 meetings. The composition of the LC A was: 1 ICT worker, 2 project leaders, 2 project engineers/modellers, 3 mechanics, 1 structural engineering teacher and 1 facilitator (total of 10). And the composition of LC B was: 2 project leaders, 2 project engineers/modellers, 1 mechanic, 1 workshop supervisor, 1 structural engineering teacher and 1 facilitator (total of 8). All the LC participants were male. The participants work in different teams and departments. Also, a researcher was present, mainly observing the LC and letting them fill out questionnaires. Across meetings, the number of attendants varied, due to members which were unable to attend the meeting and the invitation of additional external people.

All the participants signed an informed consent form to take part in the research upfront, including the permission to be recorded. The ethical approval was retrieved from the ethics committee of the University of Twente for gathering the data for the project Hit the Gas!. The researcher signed a contract to handle the data with care and to use it confidential and anonymously.

Instruction and characterization of facilitators

The facilitator was always present during the meetings. The facilitator differed per LC, respectively facilitator A and facilitator B. The facilitators received a manual about the facilitation process. The manual mostly consists of an explanation of the design principles of the LC and how to ensure them as a facilitator. In addition, the manual informed about practicalities: what is needed to organise a learning community and what needs to happen at what moment. The facilitators also received a briefing where the previously mentioned design principles of Van Rees et al. (2022) were explained.

Both facilitators will be described. Facilitator A is an HRD-teacher and researcher at a university of applied science in the Netherlands. The facilitator has no knowledge of the topic of the LC, but he does have experience in the management of change processes. Also, the facilitator does not possess previous experience with facilitating or LCs but does have an affinity with coaching, teaching, and working with groups. Facilitator B is self-employed and possesses previous experience as a facilitator, change manager, and founder of multiple LCs. Facilitator B has no knowledge of the topic of the LC but has knowledge of change processes. The facilitator thus has experience with facilitating and LCs.

Topic and set up of the LCs and meetings

The goal of the LC A was to analyze the integration of a new computer system (BIM360). The goal of LC B was to identify how the pre-manufacturing of heat pumps could be optimized within the company. The set-up of each meeting is summarized per LC in Table 1. A difference between the meetings of the LCs can be derived from Table 1. LC A followed almost the same structure repeatedly: checking in on the agreements, checking in on what everybody did this week, what problems were faced during experimenting with the program and how can we overcome these problems with our next agreements. See also Example 1 and Example 2 for illustrations of this behaviour.

Example 1

F(A): yeah okay, nice. Just [R], have you been able to test any things in the last two weeks when it comes to those alerts and those notifications and so on?

Example 2

F(A): Yeah, okay okay. [R] and [B] do you have any other things that you say, well maybe that's, that's useful to try out or that's not going so easily yet or something like that?

Table 1

Summary of the set-up of each meeting of both LCs

LC A		LC B	
Meeting number	Summary	Meeting number	Summary
1	Introduction of BIM360 and retrieving the current situation of the experience of everybody.	1	Introduction, the goal of the LC, inventory of challenges regarding prefab.
2	Discussing the experiences and where to go next with certain problems.	2	Talking over individual learning objectives by prioritizing the discussed challenges and creating shared objectives.
3	Discussing the experiences and where to go next with certain problems.	3	Discussing how the company can work smarter using prefab (action plan), discussing what information is not there yet and needs to be retrieved.
4	Discussing the experiences, discussing next steps including how to share this with the rest of the company.	4	Sharing the history of prefab in the company and the current situation.
5	Preparing meeting with the supplier, discussing experiences, and next steps.	5	Discussing examples of prefab and diving into the context. Discussing the vision of the company on the prefab.
6	Discussing similar companies and how they tackle things, discussing experiences.	6	Discussing the impracticalities of prefab. Discussing the need for a project engineer to help the prefab leader.
7	Discussing the matrix with who is responsible for what in the system and how to share information with other people. Discussing how to proceed with the LC.	7	(Re)sharing personal learning objectives, (first in smaller groups and later in plenary). and updates for these objectives (current situation). Discussing the need of a project engineer to help the prefab leader.
8	Checking the to do's, discussing the faced problems and evaluating the LC and its objectives. Looking into the future.	8	Discussing the process of prefab, and how to meet the growth ambition.

	Meeting number	Summary
	9	Talking over impracticalities with HR-manager.
	10	Discussing how to communicate prefab possibilities with the rest of the company. Evaluating LC, looking into the future.

While LC B was more unstructured in the sense that every meeting seems had its own goal. It did not follow the same structure for every meeting. Sometimes a goal of the meeting was that a certain member presents something or needs to bring cases, information, or experiences into the meeting. In this case, the facilitator often gave the word or the floor to a member (see Example 3). Or the goal of the meeting was to talk about the learning goals (see Example 4). The structure and the goal of a meeting often seem suggested by the facilitator (see Example 5 and Example 6). In the examples, the facilitator steers in the direction of what will happen next meeting, and what is needed for that. Or he gave the word to another member to execute the plan which was decided beforehand.

Example 3

F(B): Yes. [G2] can I give you the floor?

Example 4

F(B): Personal top three who wants to start? Who wants to start? Yes, the person on the opposite of me.

Example 5

F (B): I'm going to try to pour this into short-, and long-term goals. I'll send that to you guys on Monday or Tuesday. Is that agreed upon? And then we'll go next week, I think it's Thursday, end of the afternoon Thursday next week. (…) We are going to make an action plan and agree on short- and long-term goals. It feels a bit like unfinished business yet, I think we are not quite there yet with short- and long-term goals. Or are we?

Example 6

F(B): guys, just a moment, because we are already over the time, unfortunately. We could sit for hours in my opinion, but we asked [J] some more questions, you picked some more things. As far as I'm concerned, we'll leave those for next time. But do we have to figure out the things for next time?

J: yes well, I would like to show that thing for next time

F(B): yes

Procedure

Every meeting was videotaped with a 360-degree camera. These videotapes allowed the researcher to observe and analyse the LCs afterwards. At first, the data was transcribed. Not all of the available audio could be transcribed as it was inaudible. This was transcribed as *inaudible*. To keep the data non-traceable, specific information was not transcribed. This included names of people, company names, place names and project names. After transcribing, the data was coded using ATLAS.ti. The data was coded for three variables: team learning, who initiates the TLE and the facilitator's behaviour when the facilitator initiated a TLE. One researcher participated in the coding process. A priori (deductive) codes were applied to the data based on codebooks of prior research. For the three different variables, this process will be explained more in-depth.

Coding team learning

Team learning was coded following the procedure of Bron and Endedijk (submitted). First, the data was segmented into episodes. An episode changed when the topic switched. After all the data was segmented, it was decided which topics were regarded as team learning and which were not. An overview of the topics of the team learning episodes (TLEs) and non-TLEs can be found in Appendix A. The TLEs were coded next with the BTLPs from Decuyper et al. (2010) using the codebook from Bron and Endedijk (submitted) shown in Table 2.

Table 2

Codebook for the BTLPs by Bron and Endedijk (submitted)

BTLP	Definition (cited from Decuyper et al. 2010))	Description	Exclusion criteria
Sharing	The process of communicating knowledge, competencies, opinions or creative thoughts of one team member to other team members, who were not previously aware that these were present in the team.	When all topic-relevant information introduced to the team in the episode is coming from one team member, only interrupted by (verification) questions, confirmations or statements that do not add information to the topic at hand	
Co-construction	The mutual process of developing shared knowledge and building shared meaning by refining, building on, or modifying an original offer in some way. Team members take the interaction one step further as they engage in repeated cycles of acknowledging, repeating, paraphrasing, enunciating, questioning, concretizing, and completing the shared knowledge, competencies, opinions or creative thoughts.	When other team member(s) build further on the information presented by a first team member by: - Asking for more information by means of an open question - Adding information (e.g. additional arguments, specifying conditions, etc.) - Presenting contradicting information - Coming up with possible solutions	Co-construction can also end with a disagreement in opinions without further elaboration.
Constructive conflict	A process of negotiation or dialogue that uncovers diversity in identity, opinion, etc. within the team. It is defined here as a conflict or an elaborated discussion that stems from diversity and open communication.	When a difference in opinion between team members is expressed and actively discussed by: - Providing arguments and counterarguments	-Constructive conflict is a between person process and is not: different perspectives elaborated upon by one person. - Asking questions about presented (counter)arguments and information

Coding who initiates team learning

The initiation of team learning is measured by analysing the first unit of communication of a TLE. The first communication is regarded as the first speech of somebody, only interrupted by an agreement or other forms of communication that do not add to the content or discussion. For an example of an interruption that was not regarded as an addition to the content, see Example 7. When the facilitator initiated an episode, it was coded: facilitator. If another member initiated the episode, it was coded: member.

Example 7

> F(B): We're going to go to [R] for a moment, because [R] is just listening now. The statement was that a project engineer must be there in the workplace.
> R: yes
> F(B): what do you think?

Coding facilitator's behaviour

When the TLE was initiated by the facilitator, this communication unit was further coded showing the facilitator's behaviour. For this the code scheme *Interaction Process Analysis* of Bales (1950) is used, complemented by the descriptions in the research of Nam et al. (2009). The purpose of the first communication unit was analyzed. For example, Example 7 shows that the facilitator seems to give information "We are going to [R]," but the goal was to ask his opinion "What do you think?". The purpose was to retrieve information from another member, so this then was coded as asking, even though giving was also taking place. The purpose of the first communication units were all on task level. Sometimes there was some laughter or joking, but it was never the main purpose of the communication unit. Therefore, only the task level was considered, and the codes on socio-emotional areas are thus not applied and therefore left out of this research. The codebook of the task area, with a description based on Bales (1950) and Nam et al. (2009) and examples of data from the current study could be found in Table 3. The codebook of the excluded socio-emotional area could be found in Appendix B.

Table 3

Used part of the codebook for facilitator's behaviour, adapted from Bales (1950) and Nam et al. (2009): task area.

Code	Description: first from (Bales, 1950) and second from (Nam et al., 2009) and an example from one of the papers.	Examples from the data of the current study
Giving (A)		
Gives *Suggestion* (a)	1. Direction, implying autonomy for other 2. Any act that offers direction/action for how to engage the task "I think we should get that."	F: Okay. For now, I think it's good, [R4], you've already started, that you share what the elaboration could be. When it comes to the tasks and the roles within Bim360 docs of the different colleagues.
Gives *Opinion* (b)	1. Evaluation, analysis, expresses a feeling, wish 2. Any act that advances a belief or value that is relevant to the task "It seems to me that we have gone in pretty heavily for secretarial help"	M: Yes well, I can tell you, it is being held back from all sides.
Gives *Orientation* (c)	1. Information, repeats, clarifies, confirms, 2. Any act that reports factual observations or experiences "At the end of our last meeting we decided that we would have to consider our budget"	F: Guys, it's time for the collective goal. I want to be done in 20 minutes.
Asking (B)		
Asks *Orientation* (c)	1. Information, repetition, confirmation 2. Any act that requests factual observations or experiences "Has anybody gone over our expenditures to date?"	F: [R3] how have you been sailing these past few weeks? When it comes to bim360?

Code	Description: first from (Bales, 1950) and second from (Nam et al., 2009) and an example from one of the papers.	Examples from the data of the current study
Asks *Opinion* (b)	1. Evaluation, analysis, expression of feeling 2. Any act that requires a belief or value that is relevant to the task "What do you think of this move?"	F: We're going to go to [R] for a moment, because [R] is just listening now. The proposition was: a project engineer must be there in the workplace. R: yes F: what do you think?
Asks *Suggestion* (a)	1. Direction, possible way of action 2. Any act that requests direction/action for how to engage the task "Do you want to go ahead and decide whether we should buy that piece of equipment?"	F: And it's about those runners and those soft runners so to speak. What do you do with that? Suppliers we've talked about. And we've talked about the contractors. So, the different stakeholders on the playing field. Are there other aspects that we should not forget? Things that we're missing.

Aggregation based on these codes. Bales categorized his codes in two ways, also noted in Table 3: the first one is regarding the *nature* of the behaviour (giving [A] and asking [B]). And the second one is regarding the *content* of the behaviour (suggestions [a], opinion [b] and orientation [c]). Thus, two aggregations of the codes can be made based on Bales (1950). When analyzing the facilitator's behaviour, it will be done using these aggregations:

    1) Giving or asking (the *nature* of behaviour)

    2) Suggestion, opinion or orientation (the *content* of the behaviour).

Analysis

    The qualitative data is first quantified, meaning the frequencies for all the codes of the different variables are computed using frequency analysis. Firstly, it should be noted that the LCs differ from each other regarding the topic, online or physical setting, the background of

the facilitator, the set-up of the meetings, the ratio of who initiates TLE[1], and the content of the facilitator's behaviour[2]. Because of these differences, the LCs are analyzed separately. But to check for possible results that are existent beyond one single case, the aggregated data is also analyzed. This can indicate results that are not case bound.

　　　To test the relationship between the different variables, Fisher's exact test and chi-square test are used. The choice for the Fisher's exact test or chi-square test is based on the assumptions of a chi-square. When the assumptions of a chi-square test of interdependence are met -no expected values of less than one, not more than 20% of the expected values lower than five (Kim, 2017; McHugh, 2013)- this test is used. However, when the assumptions of a chi-square test are not met, this test cannot be used, and Fisher's exact test is used instead (Kim, 2017).

　　　For RQ 1 a chi-square test is used to analyze who initiates the TLEs, and a Fisher's exact test is used to analyze who initiates which BTLPs. For RQ 2 a Fisher's exact test is used to analyze the relationship between the content and nature of the facilitator's behaviour and the BTLPs. For RQ 3, the changes over time were analyzed for who is initiating the TLEs and for the content and nature of the facilitator's behaviour. Two different approaches were taken regarding the change over time. Firstly, the data is separated into two parts to be able to compare the first set of meetings with the last set of meetings. For LC A, the data of the first four meetings are aggregated in the first set, and the data of the last four in the last set. For LC B the data of the first five meetings are aggregated, as well as the data of the last five meetings. The data of both LCs were also aggregated to study possible existent results that go beyond the separate cases. For this the first set of meetings of LC A is combined with the first set of meetings of LC B, as well as the last sets of meetings. Secondly, the differences per meeting were analyzed to compare the different meetings. The data of the LCs are not aggregated but only handled separately, because LC B has two more meetings, and these couldn't be aligned correctly with the meetings of LC A.

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[1] The difference between LC A and LC B is tested with a chi-square analysis: ($\chi^2(1) = 8.507$, $p = .005$).
[2] The difference between LC A and LC B is tested with a chi-square analysis: ($\chi^2(2) = 17.386$, $p < .001$).

Results

Descriptives

In Table 4 the total number of TLE and non-TLE per LC are noted, as well as the distribution of the different BTLPs. Of all the BTLPs, co-construction is observed the most, after which constructive conflict is observed the most. Sharing is the less observed. This means that most of the knowledge and meaning are constructed together, with no conflict. Just the sharing of information by one person with only verifications questions is thus observed the least.

Table 4

Number of TLEs, non-TLE's and BTLPs per LC

LC	Number of (non-)TLEs				Number of BTLP-episodes					
	TLE		Non-TLE		Sharing		Co-construction		Constructive Conflict	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
LC A	80	66	42	34	5	6	64	80	11	14
LC B	126	80	31	20	5	4	95	75	26	21
LCs combined	206	74	73	26	10	5	159	77	37	18

Per meeting, the number of TLEs and the length of the meetings can be found in Table 5. The length of the meetings is measured in recorded minutes. It differs when the recording started and ended, and how much of the informal introduction and ending are included in the recordings. But it is the closest way of describing the overall length of the meeting. The distribution of the different BTLPs per meeting can be found in Figure 1 for LC A and in Figure 2 for LC B.

Table 5

Number of TLE per meeting for LC A and LC B

LC	Meeting number											
	1			2			3			4		
	n	*%*	Length	*n*	*%*	Length	*n*	*%*	Length	*n*	*%*	Length
LC A	8	10	58 min	14	18	64 min	14	18	56 min	11	14	61 min
LC B	17	13	58 min	11	9	58 min	17	13	70 min	13	10	83 min

LC	Meeting number											
	5			6			7			8		
	n	*%*	Length	*n*	*%*	Length	*n*	*%*	Length	*n*	*%*	Length
LC A	10	12	54 min	8	10	55 min	7	9	49 min	8	10	45 min
LC B	9	7	52 min	12[a]	10	87 min	15	12	75 min	12	10	83 min

LC	Meeting number					Total TLE			General length	
	9			10			*n*	*M*	*SD*	*M*	*SD*
	n	*%*	Length	*n*	*%*	Length					
LC A							80	10	2,6	55 min	5,6 min
LC B	10	8	88 min	10[a]	8	64 min	126	12,6	2,7	71 min	12,6 min

[a] In LC B meeting 6 and 10 are not fully recorded. It is not sure how many minutes were not recorded since the end time of the meeting is not noted.

Figure 1

Number of BTLP episodes per meeting for LC A
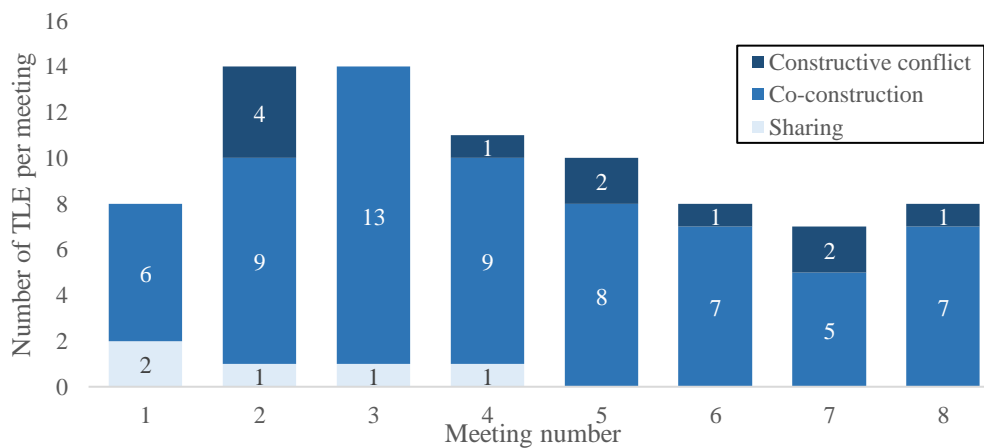
Figure 2

Number of BTLP episodes per meeting for LC B
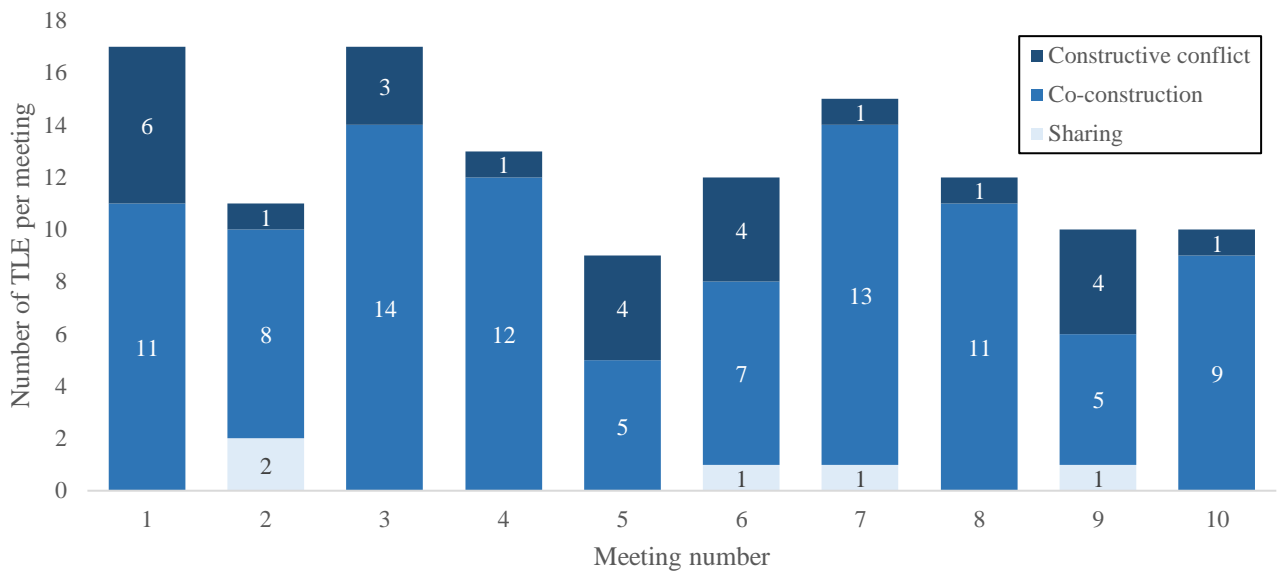
RQ1: To what extent does the facilitator (versus the members themselves) initiate team learning processes in an LC?

There is a significant difference between who initiates a TLE in LC B ($\chi^2(0) = 40.050$, $p < .001$), as well as in LC B ($\chi^2(0) = 16.974$, $p < .001$), and in both LCs aggregated ($\chi^2(0) = 52.505$, $p < .001$). The observed and expected numbers can be seen in Table 6. The discrepancies between the observed and expected numbers and the corresponding percentages indicate that the facilitator initiates more TLE than the other members.

Table 6

Number of TLEs initiated by the facilitator or the other members per LC

TLE initiated by	LC A		LC B		LCs combined	
	n	*%*	*n*	*%*	*n*	*%*
Facilitator	69[40]	86	86[63]	68	155[103]	75
Members	11[40]	14	40[63]	32	51[103]	25

Note. Formatted as Observed[Expected].

There is no significant difference between which BTLP is initiated by the facilitator or another member in LC A (Fisher's exact value(2) = 0.672, p = .841) as well as in LC B (Fisher's exact value(2) = 4.874, p = .079). In LC B it is indicated that there is a trend. In both LCs combined there is a significant difference between which BTLP is initiated by the facilitator or another member (Fisher's exact value(2) = 6.136, p = .043).

The observed and expected numbers and percentages can be found in Table 7. The trend visible in LC B is further analyzed by comparing the observed and the expected numbers. The discrepancies between the observed and expected numbers indicated that co-construction is more initiated by the facilitator than was expected, while constructive conflict is more initiated by the other members than was expected. For both LCs aggregated the discrepancies between the observed and expected numbers also indicated that the significant difference is related to co-construction being more initiated by the facilitator than expected, while constructive conflict is more initiated by the other members than expected. It should be noted that the facilitator initiated in general more TLE and therefore also initiated more constructive conflict than the members. But constructive conflict is relatively more initiated by the members as seen in the discrepancies between the observed and expected numbers.

Table 7

Number of the BTLPs initiated by the facilitator or the other members per LC

TLE initiated by	LC A						LC B					
	Sharing		Co-construction		Constructive conflict		Sharing		Co-construction		Constructive conflict	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Facilitator	5[4]	100	55[55]	86	9[10]	82	4[3]	80	69[65]	73	13[18]	50
Members	0[1]	0	9[9]	14	2[2]	18	1[2]	20	26[30]	27	13[8]	50

TLE initiated by	LCs combined					
	Sharing		Co-construction		Constructive conflict	
	n	*%*	*n*	*%*	*n*	*%*
Facilitator	9[8]	90	124[120]	78	22[28]	59
Member	1[2]	10	35[39]	22	15[9]	41

Note. Formatted as Observed[Expected].

RQ2: Which facilitator's behaviour initiates team learning processes in an LC?

The frequencies of the observed facilitator's behaviour at the beginning of TLEs are displayed in Table 8 for LC A and in Table 9 for LC B. The figures will be discussed per LC. Within LC A, the facilitator asked more than he gave (see Table 8). Furthermore, the facilitator used a lot of orientation (41). This can be related to the fact that the facilitator often asked what certain members had done with the program, what their observations were in the working place, and if they had done something new. So, this is about asking for information, observations, or experiences as displayed in Example 8.

Table 8

Frequencies of the facilitator's behaviour in LC A

Aggregation on nature		No aggregation		Aggregation on content		
		Give suggestion	6			
Gives	17	Give opinion	0			
		Give orientation	11	41	10	18
		Ask orientation	30			
Asks	52	Ask opinion	10			
		Ask suggestion	12			
Total: 69 TLEs initiated by the facilitator						

Example 8

> F (A): okay, just another point, um [R2], the question you formulated within the consultation was that you would like to know more about the communication function within bim360 docs. Have you made any progress with that, have you had any new contacts about that? Or is that still a question for you?

For LC B, the facilitator also asked more than he gave (see Table 9). However, the orientation is not as high as in LC A. He used more suggestions to initiate TLE. He often asked what could be done to move on or what the members think is the next step, these questions often left room for suggestion (see Example 9).

Table 9

Frequencies of the facilitator's behaviour in LC B

Aggregation on nature		No aggregation		Aggregation on content		
Gives	18	Give suggestion	7			
		Give opinion	1			
		Give orientation	10			
		Ask orientation	13	23	28	35
Asks	68	Ask opinion	27			
		Ask suggestion	28			
Total: 86 TLEs initiated by the facilitator						

Example 9

F (B): Are there any other things we would like to discuss next week?

The content as well as the nature of the facilitator's behaviour are checked across the different BTLPs for both LCs. At first, the content of the behaviour is analyzed. There is no significant relationship between the content of the facilitator's behaviour and the BTLPs in LC A (Fisher's exact value(4) = 4.262, p = .325), in LC B (Fisher's exact value(4) = 1.814, p = .816) as well as for in LCs combined (Fisher's exact value(4) = 2.940, p = .572). The non-significant results indicated that whether the facilitator initiated TLE with suggestions, opinions, or orientations, it did not lead to a different BTLP. The observed and expected numbers can be found in Table 10.

Table 10

Relationship between content of the facilitator and the BTLPs per LC

Content	LC A						LC B					
	Sharing		Co-construction		Constructive conflict		Sharing		Co-construction		Constructive conflict	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Suggestion	1[1]	20	14[14]	25	3[2]	33	1[2]	25	27[28]	39	7[5]	54
Opinion	0[1]	0	7[8]	13	3[1]	33	2[1]	50	23[22]	33	3[4]	23
Orientation	4[3]	80	34[33]	62	3[5]	33	1[1]	25	19[18]	28	3[3]	23

Content	LCs combined					
	Sharing		Co-construction		Constructive conflict	
	n	*%*	*n*	*%*	*n*	*%*
Suggestion	2[3]	22	41[42]	33	10[8]	45
Opinion	2[2]	22	30[30]	24	6[5]	27
Orientation	5[4]	56	53[51]	43	6[9]	27

Note. Formatted as Observed[Expected].

There is a significant relationship between the nature of the facilitator's behaviour and the BTLPs in LC A (Fisher's exact value(2) = 7.359, *p* = .018) and in the LCs combined (Fisher's exact value(2) = 11.051, *p* = .003). For LC B Fisher's exact test indicated a trend, but no significant relationship (Fisher's exact value(2) = 5.561, *p* = .059). The observed and expected numbers are noted in Table 11. The differences between the observed and expected numbers show that asking seems to have initiated more co-construction and giving seems to have initiated more sharing.

Table 11

Relationship between the nature of the facilitator and the BTLPs per LC

Nature	LC A						LC B					
	Sharing		Co-construction		Constructive conflict		Sharing		Co-construction		Constructive conflict	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Giving	4[1]	80	11[14]	20	2[2]	22	2[1]	50	11[14]	16	5[3]	48
Asking	1[4]	20	44[41]	80	7[7]	78	2[3]	50	58[55]	84	8[10]	62

Nature	LCs combined					
	Sharing		Co-construction		Constructive conflict	
	n	*%*	*n*	*%*	*n*	*%*
Giving	6[2]	67	22[28]	18	7[5]	38
Asking	3[7]	32	102[96]	82	15[17]	68

Note. Formatted as Observed[Expected].

RQ3: Does the way of initiating team learning processes change over time in an LC?

The results of both sub-questions will first show the difference between the first and the last set of meetings, and subsequentially the differences per meeting.

RQ 3.1 Does the ratio between who is initiating TLE change over time?

Data separated into the first and the last set of meetings. Computing a Fisher's exact test for LC A was not possible within the limited capacity of SPSS 25. The assumptions of a chi-square test were violated, and thus also not feasible, causing no results for LC A. For LC B the Fisher's exact test indicated no significant difference for who is initiating TLEs in the first and last set of meetings (Fisher's exact value(1) = 1.095, *p* = .340). Computing a Fisher's exact test for the LCs combined was not possible within the limited capacity of SPSS 25. A chi-square test was thus used since no assumptions were violated. However, because this is a different test, comparing the results should be done with great care. For the LCs combined there is also no significant difference ($\chi^2(1) = 0.064$, *p* =.872). Keeping the limitations in mind, this carefully indicates that who is initiating TLE was not changing over time. The observed and expected numbers can be found in Table 12, this table also shows no big discrepancies between the observed and expected numbers.

Table 12

Relationship between who initiates TLE and the first and last set of meetings per LC

Set of meetings	LC A				LC B			
	Facilitator		Members		Facilitator		Members	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
First set	42[41]	61	5[6]	45	43[46]	50	24[22]	60
Last set	27[28]	39	6[5]	55	43[40]	50	16[18]	40

| Set of meetings	LCs combined			
	Facilitator		Members	
	n	*%*	*n*	*%*
First set	85[86]	55	29[28]	57
Last set	70[69]	45	22[23]	43

Note. Formatted as Observed[Expected].

Data separated per meeting. Fisher's exact test indicated no significant difference for who is initiating TLE per meeting in LC A (Fisher's exact value(7) = 7.340, *p* = .205). In LC B there is a significant difference for who is initiating TLE per meeting (Fisher's exact value(9) = 29.134, *p* <.001).

The observed and expected numbers are illustrated in Figure 3 for LC A, and in Figure 4 for LC B. Figure 4 illustrates the deviating meetings regarding who is initiating TLE in LC B. The figure implies differences in the meetings 2,4,7 and 8. In meetings 2, 7 and 8 there was more facilitator initiation, and in meeting 4 there was more member initiation than expected. When analyzing the deviating meetings, the goal or the nature of the meeting stood out. For example, in meeting 4 and 6 somebody had a lot of "homework" and needed to present that homework and thus was in the lead of explaining a lot of information. Therefore, a member initiated a lot of episodes when continuing to the next topic the member needed to discuss (see Example 10 and Example 11). Which explains the higher number of member initiation than expected in these meetings.
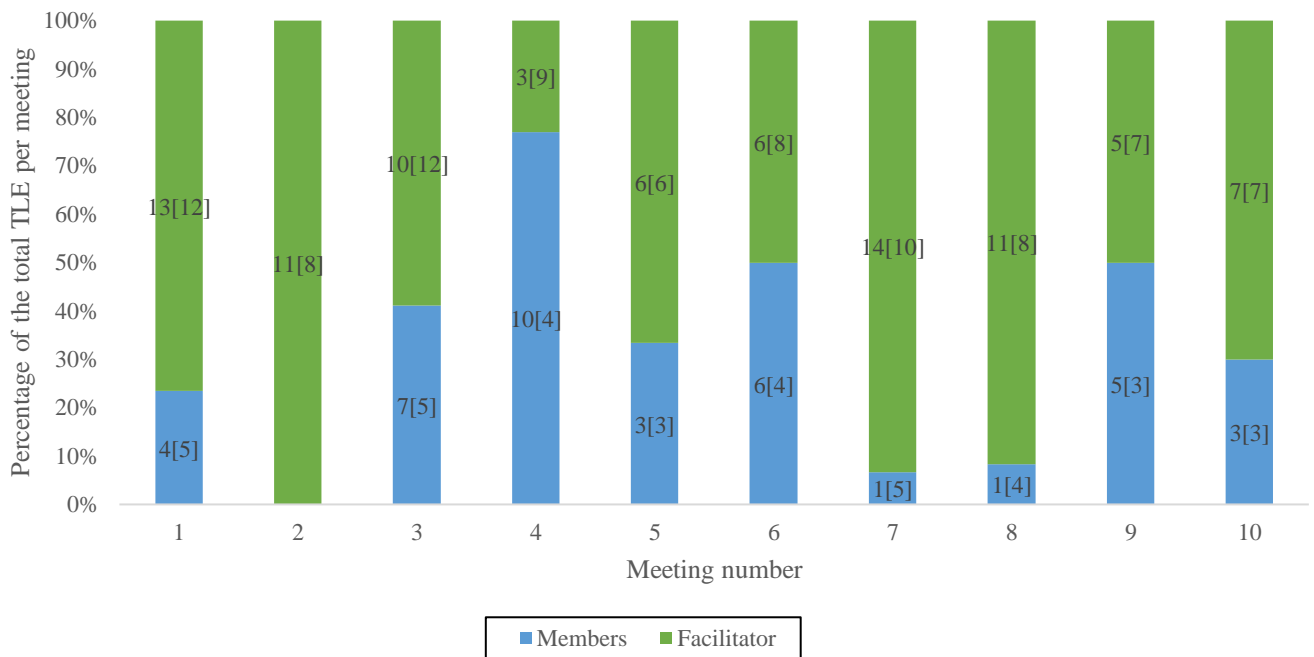
Figure 3

Number of who initiates TLE per meeting for LC A
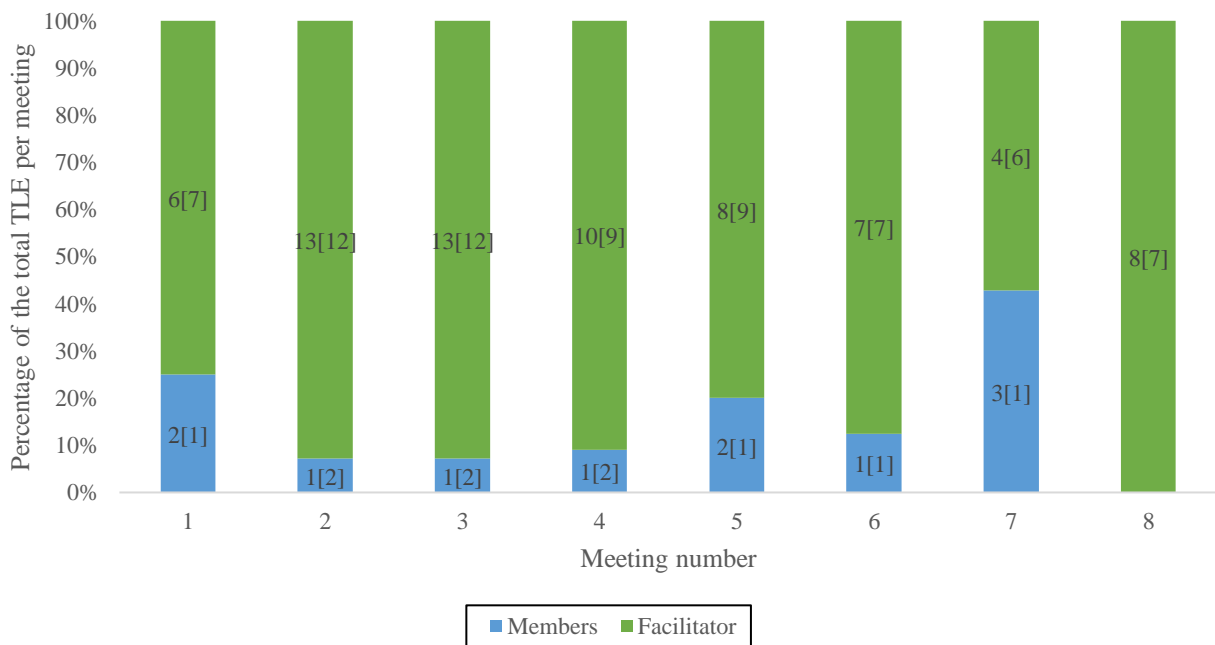
Note. Formatted as Observed[Expected].

Figure 4

Number of who initiates TLE per meeting for LC B

Note. Formatted as Observed[Expected].

Example 10

F: And [G] is now booting for his homework. To show that in a moment.

Example 11

F: [G2] we agreed last week mainly to zoom in on [place], on the project [place]. So that's what we're going to talk about, so the project history, how did certain things go, and what can we learn from that.

Member: Well, I was asked, of right indeed, of a little history, what's involved, when are you going to be involved. And what are you going to do, when are you going to do it lalala, but well. One advantage is the [brand name] heat pumps, you can do quite a bit, like last year during the vacations, we recreated six homes in [place] with [brand name] heat pump. [P] also participated in that team, let's see, no, um well. I'll just read it up.

In addition, in meeting 2, where there is no episode initiated by another member, is a meeting where the facilitator asked the members to share the learning objectives or elaborate on the main challenges they foresee in the projects. He asked the members one by one, and

the members did not interfere in that process. In meeting 7 this is kind of similar, members discussed in smaller groups the current situation of the progression in the learning objectives (see Example 12). The facilitator gave turns on who could share. This could explain the higher number of episodes initiated by the facilitator. In meeting 8 there is no real explanation or a certain goal of the meeting which can explain the higher number of episodes initiated by the facilitator than expected. The meeting had no specific goal or different set-up than the rest of the meetings.

Example 12

> F: Um, the output of the conversations. Right here [R] and [G1], what is the conclusion for you guys? Personal learning goals, did we reach those sufficiently?

RQ 3.2 Does the facilitator's behaviour initiating TLE change over time?

Firstly, the content of the facilitator behaviour will be analysed after which the nature of the facilitator's behaviour will be analysed.

Content of the facilitator's behaviour.

Data separated into the first set of meetings and the last set of meetings. There is no significant difference between the first set and last of meetings regarding the content of the facilitator in LC A (Fisher's exact value(2) = 4.440, p = .116). In LC B there is a significant difference between the first and last set of meetings (Fisher's exact value(2) = 7.582, p = .025) as well as in the LCs combined (Fisher's exact value(2) = 13.572, p = .001). This indicates that for LC B and for the LCs combined there is a change over time regarding the content of the facilitator's behaviour.

Table 13 shows the observed and expected numbers. In LC B as well for the LCs combined, the discrepancies between the observed and the expected numbers indicated the same result. They indicated that the facilitator used more orientation and suggestion to initiate a TLE in the first set of meetings, compared to the last set of meetings. In addition, it is indicated that the facilitator used more opinions to initiate TLE in the last set of meetings, compared to the first set.

Table 13

Relationship between the content of the facilitator's behaviour and the first and last set of meetings per LC.

Set of meetings	LC A						LC B					
	Suggestion		Opinion		Orientation		Suggestion		Opinion		Orientation	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
First set	12[11]	67	3[6]	30	27[25]	66	21[18]	60	8[14]	29	14[12]	61
Last set	6[7]	32	7[4]	70	14[16]	34	14[18]	40	20[14]	71	9[12]	39

| Set of meetings	LCs combined					
	Suggestion		Opinion		Orientation	
	n	*%*	*n*	*%*	*n*	*%*
First set	33[29]	62	11[21]	29	41[35]	64
Last set	20[24]	38	27[17]	71	23[29]	36

Note. Formatted as Observed[Expected].

Data separated per meeting. There is a significant difference in the content of the facilitator's behaviour per meeting in LC A (Fisher's exact value(14) = 22.030, p = .024) and in LC B (Fisher's exact value(18) = 32.307, *p* = .005). These significant results indicate that the content of the facilitator's behaviour seems to differ per meeting.

Figure 5 illustrates the observed and expected numbers for LC A. For LC A all the observed numbers differ by 1- or 2-episodes maximum compared to the expected numbers (in relation to the total n = 69). The only bigger discrepancy is that the facilitator used more orientation to initiate TLE in meeting 5 and more opinions in meeting 8. Meeting 7 seems to deviate in Figure 5, however that meeting just has four episodes initiated by the facilitator, so the observed numbers only differ two from the expected numbers. For meeting 5 there seems no explanation why there is more orientation. It looks like the other meetings in terms of structure and goal. The facilitator asked how the experiences were last week (see Example 13). However, that was asked a lot also in other meetings, so it is not clear why this meeting consists of the facilitator using more orientation for initiating TLE than expected. For meeting 8 the discrepancy can be explained by the fact that in this meeting the facilitator asked the other members to evaluate the LC as a concept, so asking for opinions, (see Example 14). In

the rest of the meetings there seem no real differences regarding why the content of the facilitator's behaviour could be different.

Figure 5

Number of TLEs initiated by the different content of the facilitator's behaviour per meeting for LC A
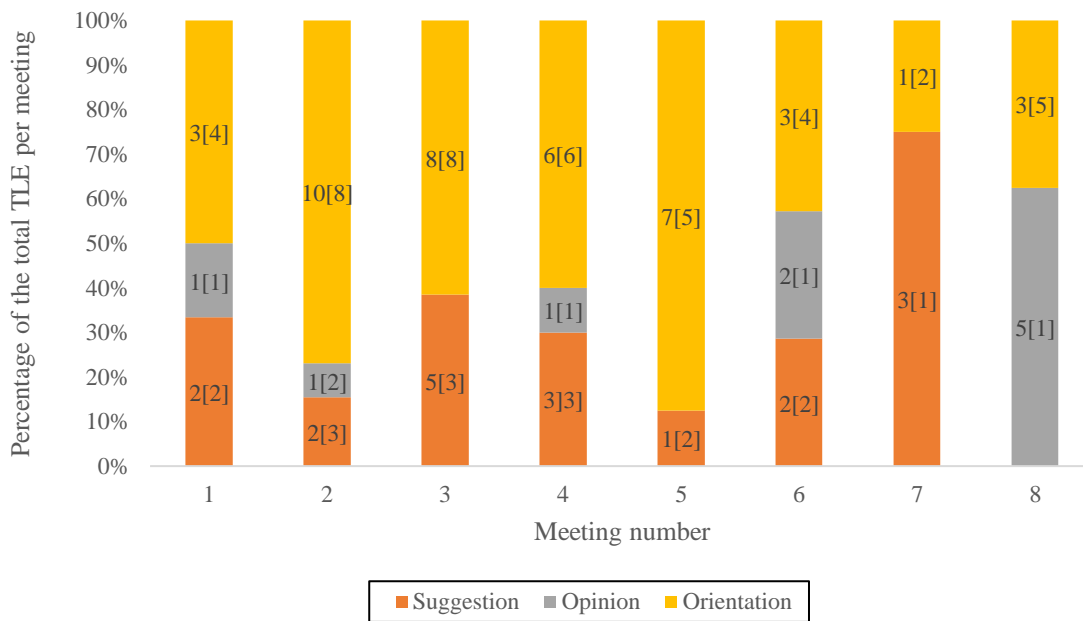
Note. Formatted as Observed[Expected].

Example 13

F: Are there any other points where you say hey that's been tried out there, I was still running into that or that didn't work out to try out or whatever?
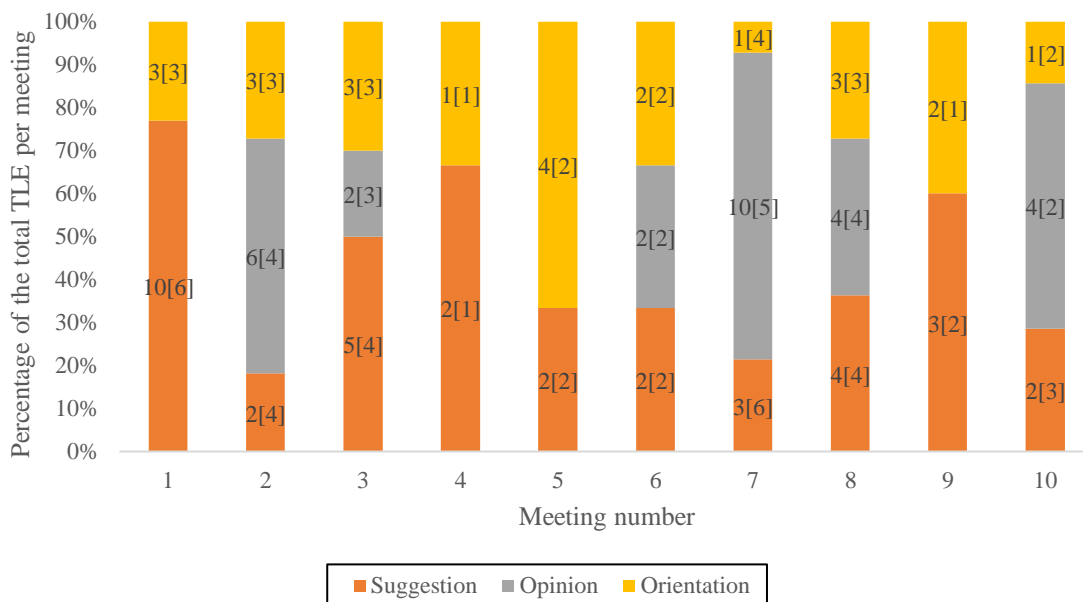
Example 14

F: eh, if you then look back at the process, eh, so working on such an issue in this way. And seeing if you can formulate an approach together and get to know how it works, what you must do and so on. What is then when you try to bring that together in this way? What has been the result of these 8 meetings? What is that for you [R3]?

Figure 6 illustrates the observed and expected numbers for LC B. The difference between the observed and expected numbers indicates four deviating meetings. Within meeting 1 the facilitator used more suggestion and less opinions for initiating TLEs than expected, also visible in Figure 6. This is because the facilitator was asking for direction in

the first meeting: which challenges should the community consider when creating a learning objective? He was thus constantly asking for suggestions or giving suggestions himself, as illustrated in Example 15. In meeting 2 and 7 the facilitator used more opinions for initiating TLE than expected. This can be explained by the fact that these meetings were about retrieving and sharing individual learning objectives. And a personal learning objective and prioritizing them is considered as opinion. So, the goal of the meeting might have caused these differences. The rest of the observed numbers do not differ by more than two from the expected cells and will therefore not be regarded as varying meetings.

Figure 6

Number of TLEs initiated by the different content of the facilitator's behaviour per meeting for LC B

Note. Formatted as Observed[Expected].

Example 15

F: So, we want to define long-term goals and define short-term goals. In other words, what are the challenges in terms of prefab? And um, and so that's what we want to focus very much on next week. So maybe you guys can respond to gosh, this is what we need to think about in terms of those challenges. If you look at yourself or if you look at the group, what are those challenges that you need to think about? Those have also come up in the individual conversations.

Nature of the facilitator's behaviour.

Data separated into the first set of meetings and the last set of meetings. Before these results are presented, it should be noted that for the LCs combined, a chi-square test is used in contrast to the other analysis where instead a Fisher's exact test is used. Therefore, the results should be compared with caution. Fisher's exact test indicated that the difference in the nature of the facilitator's behaviour between the first and last set of meetings is not significant for LC A (Fisher's exact value(1) = 0.895, p = .403), nor for LC B (Fisher's exact value(1) = 0.281, p = .792). For the LCs combined this difference is also not significant ($\chi^2(1)$ = 0.097, p = .848)[3]. This means that there seems no change over time regarding the nature of the facilitator's behaviour. Table 14 shows the observed and the expected numbers. There seem no big discrepancies between the observed and expected numbers.

Table 14

Relationship between the nature of the facilitator's behaviour and the first and last set of meetings per LC

Set of meetings	LC A				LC B			
	Giving		Asking		Giving		Asking	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
First set	12[10]	71	30[32]	58	8[9]	44	35[34]	51
Last set	5[7]	29	22[20]	42	10[10]	56	33[33]	49

| Set of meetings	LCs combined			
	Giving		Asking	
	n	*%*	*n*	*%*
First set	20[19]	57	65[66]	54
Last set	15[16]	43	55[54]	46

Note. Formatted as Observed[Expected].

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[3] Computing a Fisher's exact test for the LCs combined was not possible within the limited capacity of SPSS 25. A chi-square test was thus used since no assumptions were violated.

Data separated per meeting. There is a significant different in the nature of facilitator's behaviour per meeting in LC A (Fisher's exact value(7) =17.855, p = .004), but there is no significant difference in LC B (Fisher's exact value(9) =7.200, p = .604). These results indicate that for LC A the nature of the facilitator's behaviour differs per meeting, but that the nature of the facilitator's behaviour does not differ per meeting in LC B.

The observed and expected numbers can be found in Figure 7 for LC A and in Figure 8 for LC B. For LC B there seem no big discrepancies between the observed and expected numbers. For LC A the expected numbers are all quite close to the observed numbers but deviating enough to cause a significant difference. The meeting that really seems to deviate is meeting 1. In meeting 1 the facilitator initiated TLE more by giving than by asking compared to what is expected. This can be explained by the fact that the facilitator explained a lot in the first meeting about what the idea of the meeting and LC was. The rest of the differences are relatively small, as they deviate not more than two and thus will not be analyzed further.
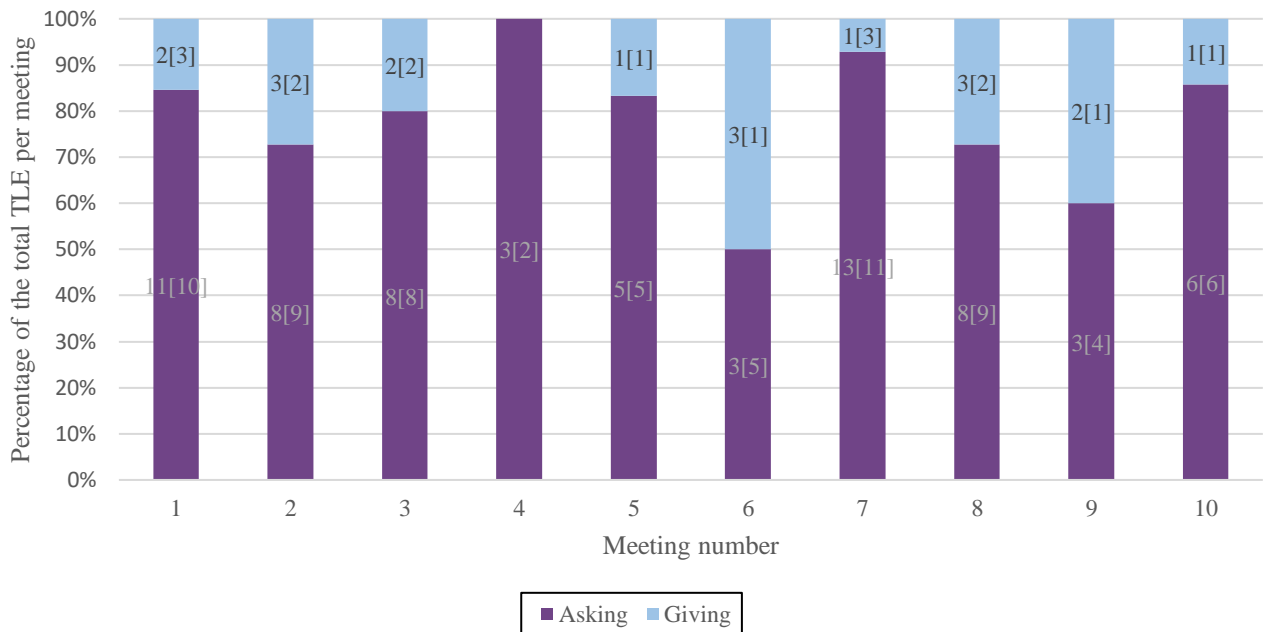
Figure 7

Number of TLEs initiated by the different nature of the facilitator's behaviour per meeting for LC A
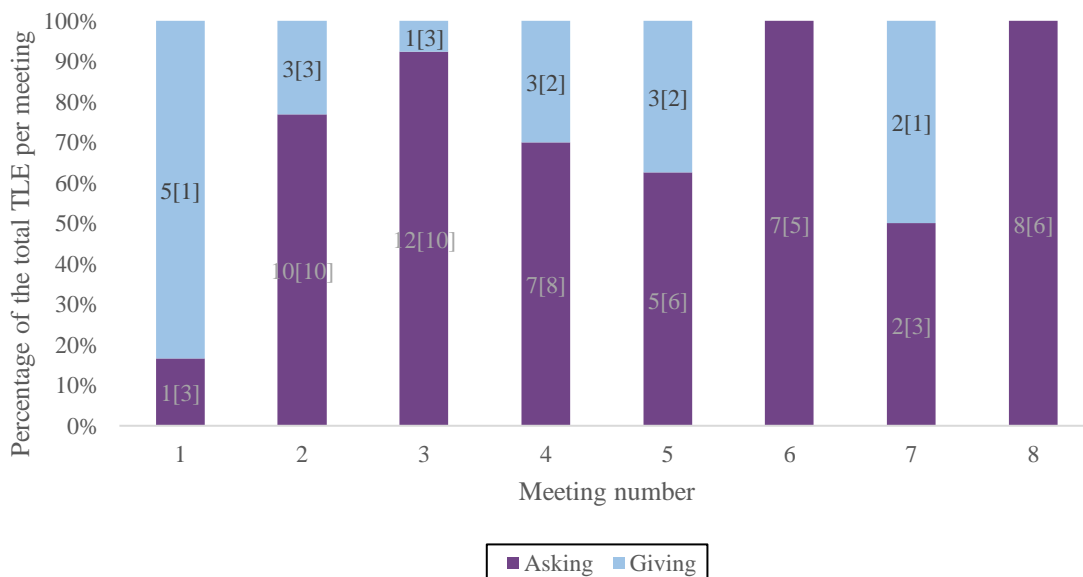
Note. Formatted as Observed[Expected].

Figure 8

Number of TLEs initiated by the different nature of the facilitator's behaviour per meeting for
LC B

Note. Formatted as Observed[Expected].

Discussion

The aim of this study was to explore the relationship between the facilitator's
behaviour and team learning within an LC, by analyzing the initiation of the BTLPs. Firstly, it
appears that the facilitator initiates more TLE in the context of an LC than the other members.
The facilitator initiates more co-construction, while members relatively initiate more
constructive conflict. Secondly, it also seems that when the facilitator initiates TLE, asking
seems to lead to co-construction and giving to sharing. There seem no other signs of a
relationship between the content or nature of the facilitator's behaviour and BTLPs. Thirdly,
the ratio of who initiates TLE (facilitator or other members) does not seem to change over
time. However, for LC B it does differ per meeting who is initiating TLE. This seems
connected to the different setup of the meetings. Lastly, the content of the facilitator's
behaviour seems to change over time. The facilitator uses more suggestion and orientation
when initiating TLE in the first set of meetings, while they use more opinion in the last set of
meetings. In addition, the content of the facilitator's behaviour varies per meeting for both
LCs. In LC B this also seems to be connected to the set-up of the meeting, while in LC A no
explanation could be found. The nature of the facilitator's behaviour does not change over

time. And in LC A it also does not vary from meeting to meeting, but in LC B it does. The conclusions will be discussed in more detail.

The facilitator initiates team learning

The first indication is that the facilitator, more than the other members, initiates general team learning. This result is also found in the combined data of the LCs, which signals that this result is existent beyond the single LCs. This suggests that the facilitator is responsible for initiating team learning and that the members are generally not self-regulating their learning process to the full extent. Diving deeper into who initiates which BTLP, the facilitator initiates relatively more co-construction, while the members initiate relatively more constructive conflict. This is also observed in the combined data, indicating that the results are existent beyond one case. These outcomes indicate that the facilitator initiates the team learning process that goes beyond sharing -co-construction-. However, the members seem to initiate relatively more the most complex learning process -constructive conflict-. In that sense the members do self-regulate their learning as when they initiate TLE, they seem to initiate the most complex BTLPs.

A possible explanation for the result that the facilitator initiates less constructive conflict could be that the facilitator is external, while the other members already know each other. Team learning can be an interpersonal risk in group dynamics (Edmondson, 2003). When team members can trust each other, psychological safety can be created, which stimulates team learning because team learning then becomes less risky (Edmondson, 1999; Van den Bossche et al., 2006). This can occur over time (Raes, Kyndt, et al., 2015), but also when team members already know each other (Raes et al., 2017). Interpersonal risk-taking, such as constructive conflict, then can already take place from the beginning. Within the LCs, the team members already knew each other, but the external facilitator did not yet. It may be that constructive conflict, which can be seen as the riskiest team learning behaviour, is thus initiated more by members, who already knew each other, than by the external facilitator. This possible explanation is supported by the result that team learning in the LCs does not seem to change over time; all BTLPs emerge already in the first meetings. However, future research should study if this possible explanation is indeed applicable to team learning in LCs. This might gain insight in if the composition of an LC has an influence on the initiation of team learning and the different BTLPs.

A second possible explanation could be methodological of nature. According to the coding scheme of Bron and Endedijk (submitted), open-ended questions lead to co-

construction. Only when there are no questions, or the questions are verification or confirmation questions, it is regarded as sharing. The facilitator very often asks in-depth questions at the beginning of a TLE, which then could be coded as co-construction. Thus, this choice made during the coding process may also have led to these results becoming visible in the data. When the coding process of the BTLPs is revisited, the results could be different. Therefore, this methodological aspect should be taken into account when discussing the results. Future research could repeat this study taking a closer look at the coding of the BTLPs to see if the results are due to the methodological choice, or if the data will still indicate the same results.

Asking leads to co-construction while giving leads to sharing

The second RQ focused on which facilitator's behaviour initiates the different BTLPs. The first indication of this is that giving leads to more sharing while asking leads to more co-construction. These results are also found when combining the data, indicating that the relationship is existing beyond the separate LCs. However, the previously discussed process of coding the BTLPs might also be a potential clarification for this result. As described in the previous paragraph, the coding scheme of Bron and Endedijk (submitted) indicates that the questions from the facilitator at the beginning of a TLE result in co-construction and giving results to sharing. In addition, another methodological choice might be related to these outcomes: considering the facilitator part of the team. When the facilitator is regarded as a non-team member this means that a frequently observed deepening question from the facilitator at the beginning of a TLE is omitted. When these questions are not considered as the initiation of the TLE, this will result in less co-construction, and more sharing. Hence, these two methodological choices might have influenced these results and thus should be considered when discussing the outcomes.

Other than the facilitator asking more than giving when initiating TLE, no other results are observed regarding the relationship between the facilitator's behaviour and the BTLPs. The answer to this research question thus indicates that for reaching a more complex BTLP - co-construction-, asking should be used by the facilitator instead of giving. However, there are no specific indications of how the facilitator's behaviour could initiate the most complex BTLP -constructive conflict-.

One possibility is that the relationship between the facilitator's behaviour and the different BTLPs is more differentiated or extensive than currently observed. This might be related to the need for the facilitator to be flexible. The behaviour of the facilitator is based on

flexibility; the facilitator needs to be sensitive and responsive to the needs of the team by showing different kinds of behaviours (van der Want & Meirink, 2020). When facilitators can facilitate with multiple styles depending on their judgement, the quality of the facilitator increases (van Maurik, 1994). This process is described by Doyle and Straus as:

> "It would be hypocritical and impossible to lay out a step-by-step procedure comparable to Robert's Rules of Order. Unlike the chairperson who can waltz to the regulated music of Robert's Rules of Order, the facilitator has to do a combination tap dance, shuffle, and tango to a syncopated rhythm produced by unpredictable humans." (In Ortquist-Ahrens & Torosyan, 2009, p. 32)

Possibly the facilitator's behaviour is so flexible that it does not allow to be measured by only the content and the nature of the facilitator's behaviour. A more differentiated relationship might exist between the facilitator's behaviour and the BTLPs, but are simply just not measured because of the used codebook of Bales (1950) for measuring the facilitator's behaviour. It might be that using a different codebook, or inductive coding could elaborate more on the relationship between the facilitator's behaviour and the different BTLPs. Future research could try to analyze the data using another codebook or inductive coding and verify whether this will give other insights. This will consequently give more insight into the use of the codebook of Bales (1950) for analyzing facilitator's behaviour in LCs. Moreover, it might lead to more in-depth results regarding which facilitator's behaviour initiates which BTLP.

Who initiates TLE is not changing over time but differs per meeting

Although the following results should be treated with care, it seems like the member initiation is not changing over time. This is contradictory to the perspective found in the literature on facilitation, which implies that the members should initiate more TLE over time, following authors like Bentley (1994) and Macneil (2001). They indicate that the facilitator should encourage the members to be more responsible for their learning process and initiate more TLE over time. This perspective is, however, not entirely observed in the LC as the member initiation is not changing over time. The research of Bentley (1994) and Macneil (2001) is conducted in work teams, which might have caused that difference in observations as the contexts differ. The not observed change over time also indicates that the members are not becoming more self-regulated in their learning, which was one of the design principles of the LCs (Corporaal et al., 2020; Van Rees et al., 2022).

Although, this perspective on facilitation can be observed partially in the LCs. In some meetings, members initiate more TLE than in other meetings. In meetings with more member

initiation, it seems like the facilitator explicitly hands over the role to a member by, in consultation with the member, assigning them a task. The task consists mostly of presenting information or sharing experiences. It seems like the facilitator hands over the role to a certain member explicitly with the task, after which the member initiates more TLEs. Hence, this seems to be a way for the facilitator to encourage member initiation and thus stimulate the self-regulation of their learning. This then seems to be partially in line with the perspective of authors like Bentley (1994) and Macneil (2001), where the facilitator should stimulate members to take responsibility for their learning. Only the change over time is missing and is observed per meeting instead.

This result seems to be a tentative and cautious suggestion that the facilitator's behaviour might initiate team learning in the same way the team leader's behaviour initiates team learning. Edmondson (2003) gave more insight in the relationship between team learning and the team leader's behaviour, by identifying two stimulating factors of the team leader. The first is motivating effort and thereby stimulating innovation and change. And the second is creating psychological safety, which can be achieved by minimizing the power differences and facilitating speaking up. By giving tasks and corresponding speaking time to a member, the facilitator quite literally facilitates speaking up and motivates the effort of the members to participate actively.

However, this interpretation should be treated with great care as motivating effort and facilitating speaking up have not been investigated in the current study, and even not in the context of an LC. The present study just wants to signify that the aspects like motivating effort and facilitating speaking up might also play a role when the facilitator initiates team learning processes. Follow-up research can integrate these aspects in investigating the relation between team learning and the facilitator in LCs. Once there is more known about if these aspects also apply to the facilitator, these results could impact the training of the facilitators. This could help the facilitator with stimulating the members to participate in team learning initiation in an LC, which will enable the members to become more self-regulated in their learning process.

The change over time in the facilitator's behaviour

Even though LC A seems to have the same set-up of the meetings, the content and nature of the facilitator's behaviour differed per meeting. And there is no certain explanation for the deviating behaviour every meeting. This might be again linked to the flexibility of the facilitator. It could be that these meetings called for different behaviour, and the facilitator

acted responsively to this (van der Want & Meirink, 2020), resulting in different facilitator behaviour. But the current research did not manage to measure the differences per meeting. These outcomes are aligned with the second perspective on facilitating, in which is stated that the facilitator should act upon the needs of the group per meeting (Shaw et al., 2010).

The results of LC B differ from LC A. Within the nature of the facilitator's behaviour, there are no differences per meeting nor change over time. However, regarding the content of the behaviour, there is a difference per meeting and a change over time. The facilitator used less orientation and suggestion when initiating TLE over time, while he used more opinion. This shows that values are talked over more in the end. And a direction or actions and information or experiences become less important over time. This can be reasonable for the LC: at the beginning, it needs to be decided where you are going and what the current situation is, and when solutions are being proposed, these are being valued.

Limitations and future research

Some limitations and suggestions for future research are already addressed, however, four limitations are still undiscussed. These will now be specified.

Limited knowledge and research about LCs

Studies on LCs are still scarce, just as the knowledge on how to design an effective LC, which causes the design and delivery of the analyzed LCs to be in a pilot phase. Van Rees et al. (2022) who also used these pilot LCs, acknowledged that more insights and research are needed, which can give indications to adjust the current design. This implies that the design and delivery of the LCs still need to be streamlined and consolidated. For example, the facilitators only received a briefing, while a complete training could be more beneficial (Shaw et al., 2010). Or aligning the facilitators more in the beginning, could create more standardized LCs.

And another disadvantage of these pilots is that they were held during the COVID-19 pandemic, resulting in varying COVID-19 measures. LC A was held online, while the LC B was able to take place in a traditional, (physical) setting. The online setting could have intertwined with the team process. Recent research shows better communication, more positive leadership perception and team culture strength in traditional teams, in contrast to virtual teams because of COVID-19 (Stratone et al., 2022). This might have affected the process of the LC.

These limitations caused the pilot LCs to be snapshots in time. LCs designed based on more research and insights, and that do not take place during (the measures of) a pandemic could lead to results that could be more convincing. This is thus also a suggestion for further research; provide more research on LCs to contribute to more carefully designed and delivered LCs to create more substantial conclusions.

Exclusion of FTLP

An additional limitation is the exclusion of the FTLPs, described next to the BTLPs in the integrative team learning model of Decuyper et al. (2010). In the design of the LCs, the facilitator is responsible to ensure the FTLPs (Corporaal et al., 2020). Leaving the FTLPs out may cause team learning to be measured too narrowly when a more in-depth insight could have been created. The relationship between the FTLPs and the facilitator's behaviour is now unknown, while this might have given new and more profound insights. Future research could study the addition of measuring FTLPs, for example following (Raes et al., 2017) to broaden this insight into team learning in an LC. This can also give more insight into if and how the facilitator initiates FTLPs.

The use of two cases

The third limitation is the use of two cases. Firstly, according to Onwuegbuzie and Leech (2007), three to five cases are needed to guarantee reliable outcomes. Two cases are thus too little to guarantee outcomes that could be generalized. Taking this into account, the results should be treated with care and only be discussed as indications instead of set-in-stone. This is also confirmed by the observed difference between the two analyzed LCs with also completely different topics. It can thus also be expected that other LCs differ also from the analyzed LCs and consequently show different relationships or generate deviating results. Some results are existing beyond the separate cases, but all the results can still not be generalized to other LCs.

Another consequence of using two cases is the small numbers in the contingency tables. This caused little data to perform only chi-square analysis and thus Fisher's exact was also used. This test is sometimes seen as conservative, which might cause significant relationships or trends in the data not to be visible. The low numbers in the contingency tables also caused another limitation. When analyzing the difference between the other members and the facilitator, the other members often consisted of nine people while the facilitator was only one person. However, this could not be fixed, since when analyzing the members individually

left us with too little data to analyze. So, the initiation of the members could not be analyzed in-depth, because all the members were added together.

Future research should consider more data. For the latter limitations, way more LCs should be analyzed to overcome these problems. Some of the cells in the contingency tables are not observed much, while others are observed a lot more. For example, because there is less member initiation, the numbers in these cells are lower. So, for increasing the numbers in these cells a lot of LCs are needed to meet the assumptions. But analyzing only a few more cases could already contribute to analyzing more cases which can create higher generalizability and more substantial results.

One researcher involved in the coding process

The last limitation is the use of only one coder in the coding process. The process of creating an inter-rater reliability score was started but it could not be finished, causing an absence of the inter-rater reliability score. An inter-rater reliability score could give an indication of the adequacy of coding, which, when sufficient, could increase the reliability of the study (Boeije, 2010). This ensures that the results and associated interpretations should be used even more cautiously than already mentioned above. Future research could replicate this study, but code the data with multiple coders and create inter-rater reliability. This could increase the reliability of the study, results, and conclusions (Boeije, 2010).

Conclusion

Given the caution with which the results and their interpretation are presented, conclusions should also be drawn thoughtfully. It appears that the facilitator initiates learning in the context of an LC team. The facilitator can move the team beyond sharing by asking questions. And in addition, the facilitator does not appear to transfer responsibility for the initiation of team learning to members, but the member initiation seems to vary from meeting to meeting, as the facilitator sometimes transfers the role to members. These initial indications may be one of the first steps in exploring the field of the use of a facilitator in relation to team learning in LCs. The proposed further research could contribute to confirming, adjusting or extending the results and their interpretations. This will eventually contribute to the design of LCs, which can be used in practice in installation companies to gather more knowledge and skills for the energy transition.

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Appendix A- Topics of team learning and non-team learning episodes

Table 1

Topic of non-TLEs and TLEs.

TLE or non-TLE	Topic (examples in brackets)
Non-TLEs	- Introductions of people
	- Practical organizational things (where are we sitting next time)
	- Chitchat (about the weather)
	- Technical issues (getting in the meeting in Teams)
	- Research (explaining research/questionnaires)
TLEs	- Meeting information (what are we going to discuss today)
	- Information about the LC (what is the aim of these meetings, what is our goal etc)
	- Learning objectives (individual and collective)
	- Creating an action plan (required information for creating an action plan, creating useful to do's, checking to do's/sharing experiences etc etc)
	- Content about BIM360 (how does it work, advantages, technical issues regarding BIM360 etc etc).
	- Content about prefab (inventory challenges, discussing the challenges, discussing impracticalities, information about specific projects etc etc).

Appendix B- Unused part of the codebook for facilitator's behaviour

Table 1

Unused part of the codebook for facilitator behaviour (adapted from Bales. 1950; Nam et al. 2009): socio-emotional area

Codes		Description
		Adapted from
		3. Bales (1950)
		4. Nam, Lyons, Hwang & Kim (2009)
		In grey an example from one of these papers
Positive Reactions	Shows solidarity	3. Raises other's Social-Emo- status, gives help, reward
		4. Any act that shows positive feelings toward another person
		"Well, I think we got through that in good shape. Old Bill certainly puts in the right word at the right time, doesn't he"
	Shows tension release	3. Jokes, laughs, shows satisfaction
		4. Any act that reduces the anxiety that a person or group may be experiencing
		"Wow, that was funny."
	Agrees	3. Shows passive acceptance, understands, concurs, complies
		4. Any act that shows acceptance of what another person has said
		Yeah I agree with you.
Negative Reactions	Disagrees	3. Shows passive rejection, formality, withholds help
		4. Any act that shows rejection of what another person has said
		"I told you, it's not allowed in here."
	Shows tension	3. Asks for help, withdraws out of field
		4. Any act that indicates that a person is experiencing anxiety "What do you think of this move?"
		"I am not happy right now."
	Shows antagonism	3. Deflates other's status, defends or asserts self
		"All she got is great looks, but I guess that's enough for Joe"