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Regular Article

Constructing collective learning

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ABSTRACT

Professional Learning Communities (PLCs) in education are intended to promote both individual and collective learning; however, collective learning does not always materialize. This study aimed to deepen our understanding of the processes that shape collective learning, by focusing on a cognitive perspective on collective learning thus complementing the more commonly used social perspective on collective learning in PLCs. This cognitive perspective consisted of collective learning as the interplay between the psychological mechanisms of self-categorization, collective attention, common knowledge, and collective identity. Using a qualitative case study approach, that involved interviewing all eleven members of two newly formed multidisciplinary PLCs, experiences with constructing collective learning were collected. A combinatory inductive and deductive analysis was performed, which confirmed the foundational mechanisms of collective learning as defined by the cognitive perspective. In addition, a fifth mechanism, *social equivalence*, was distinguished, which offers further insight into the interaction between self-categorization and collective attention during the early stages of PLC functioning. Social equivalence refers to the process through which members of PLCs attribute constructed similarities—such as shared values and norms—to their peers at an abstract level. These similarities not necessarily have a basis in reality, but they serve to foster connectivity, facilitating collective learning relationships with unfamiliar individuals.

1. Introduction

To be able to face fundamental future issues, education needs to provide future generations with the capacity to deal with shared problems collectively. Social forms of learning, such as collective learning, are known to stimulate innovation and complex problem solving, by necessitating participants to combine different perspectives on a similar topic, based on shared understandings (Castelijns et al., 2013). The concepts of similarity and diversity are central elements in collective learning, since they spark a process of sense-making in which learners attempt to align their individual or collective identity with other individual or collective identities (Gourley et al., 2021) to overcome their diversity and find common ground (Castelijns et al., 2013). This alignment is what constitutes learning outcomes for individuals and the collective, both cognitive and behavioural. Therefore individual and collective learning are viewed as interacting and self-reinforcing processes (Fenwick, 2008; Vähäsantanen et al., 2017). In addition, collective processes lead to collective outcomes, and these processes and outcomes are thoroughly intertwined with the community that is constructed through and constituted by this alignment (cf. Gourley et al., 2021).

A frequently employed method to facilitate collective as well as individual forms of learning in education is the Professional Learning Community (PLC), a community of learning in which educators collaboratively engage with a shared goal and foster a culture that enhances teaching and learning for all participants (Huffman et al., 2016). PLCs improve teaching practice (Liu, 2021) and enhance both teacher professional development and student learning (Doğan & Adams, 2018). In addition to these individual outcomes, PLCs are found to, on occasion, have collective outcomes, such as complex educational problem solving and the stimulation of organisational development (Prenger et al., 2021). However, research shows that especially the emergence of collective learning in educational PLCs is difficult to achieve (cf. Huijboom et al., 2023; Mercer, 2016). Collective learning instances in PLCs seem to be only loosely related to the configuration of the network, and the unpredictability of the phenomenon makes it difficult to stimulate and facilitate its occurrence (Huijboom et al., 2023). There is still limited understanding of the process through which collective learning is

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constructed, as well as the critical mechanisms involved.

We have conducted a small scale qualitative exploratory study, to gain in depth insight into the collective learning that is constructed at the start of two newly formed educational PLCs. The two PLCs consisted of teachers, researchers and educational advisers from two different organizations. The question we set out to answer was: 'How is collective learning constructed in professional learning communities composed of professionals with diverse educational backgrounds?'. Collective learning is in educational sciences generally approached as a predominantly social process. In this study, however, we approach collective learning from a new angle, as a cognitive learning process constituted by psychological mechanisms, which we discuss in the following section.

2. Theory

2.1. Perspectives on collective learning

Collective learning is a process that has received attention from diverse fields and been described from multiple perspectives in the last decade (Crosscombe & Lawry, 2022; Forchtner & Schneickert, 2016; Heikkila & Gerlak, 2013; Krafft et al., 2021). Collective learning is generally defined as a social process involving joint activities in a certain social configuration, resulting in shared outcomes, which on the collective level can be described as more than the sum of individual learning (Castelijns et al., 2013). These shared outcomes are collective understandings regarding the learning process and the learning that is achieved (Garavan & McCarthy, 2008) and can be concretized as knowledge, new ways of working or artifacts (Heikkila & Gerlak, 2013; Wenger et al., 2011). Collective learning is described as a dynamic, cumulative social interaction process (Burini & De Lillo, 2019), involving 'coordinated joint commitment to a shared goal, reciprocity, mutuality and the continual (re)negotiation of meaning' (Mercer & Howe, 2012, p. 15). It requires learners to exchange information, knowledge and perspectives, in addition to taking risks and remaining open for failure (Bunderson & Reagans, 2011). This joint commitment to a shared goal incorporates maintaining a shared conception of the problem or task at hand and can induce emotional states such as feelings of 'group sense' or belonging (Castelijns et al., 2013).

While this perspective of collective learning as a social process has a relative long tradition in educational sciences (cf. Wenger-Trayner, Wenger, & Wenger-Trayner, 2020) the perspective of collective learning as a cognitive process is quite recent (Shteynberg, 2015, 2018; Shteynberg et al., 2020, 2023). Collective learning as a cognitive process can be described as 'the cognitive capacity of collective attention that indicates and represents common knowledge across group members, yielding mutually known representations, emotions, evaluations, and beliefs' (Shteynberg et al., 2020, p. 2). In this definition collective learning is perceived as the interplay between psychological mechanisms, such as *collective attention* and *common knowledge*, which foster feelings of connectedness and a sense of belonging among group members—forming the psychological foundation of collective identity. These mechanisms are deeply interconnected and often occur simultaneously, enabling typical human development to share experiences and build knowledge together (Skorich et al., 2017). To examine the interaction between these mechanisms, we will first disentangle them.

2.2. Mechanisms for collective learning

Collective attention (Skorich et al., 2017) is the experienced shared attention of two or more individuals for the same object or occurrence. It can be described as 'a psychological capacity whereby all co-attending agents cognitively prioritize collectively attended stimuli over non shared stimuli, yielding cognitive alignment among the co-attendants' (Shteynberg et al., 2020, p. 923). The acquisition of the capacity to attend collectively starts in early infancy with the construction of self-other-object relations, initiated by gaze contact, which facilitates and stimulates the acquisition of complex systems of social norms and knowledge, such as language (Stephenson et al., 2021). Collective attention is found to have several advantages over individual attention. Attending together improves recall memory, amplifies emotions, intensifies attitudes, increases goal pursuit, and strengthens learning (cf. Edward et al., 2014). These advantages arise not only when attention is truly collective; even when an individual simply believes that someone else is co-attending to their task, their performance improves (Shteynberg et al., 2020).

Collective attention indicates and facilitates the construction of knowledge that is shared by all individuals co-attending, such as language in early infancy. This knowledge is referred to as common knowledge. Common knowledge is formed through the exchange of information and the construction of shared mental representations through interaction and communication within a collective (Edward et al., 2020; Wenger-Trayner et al., 2020). Common knowledge is a fundamental component of collective learning. It consists of the shared understanding and information that arise through interaction, communication, and collaboration among individuals within a community, supported by collective attention. In collaborative and participatory learning environments, individuals actively contribute, share perspectives, and collectively construct meaning, making such environments essential for the development and dissemination of common knowledge (Edward et al., 2014). The nature of common knowledge is shaped by social norms, institutional structures, and cultural practices (Siposova & Carpenter, 2019), which themselves are also part of common knowledge.

The social norms, institutional structures, and cultural practices that are part of common knowledge stimulate the construction of a *collective identity*, were people are members of a certain group with a certain identity (Skorich & Haslam, 2022; Stheynberg et al., 2020). This sense of collective identity is constituted by both the construction of collective attention with others and the common knowledge that is constructed in this process. It is both the outcome of the process and the process itself. Having a collective identity facilitates the construction of collective attention, since feelings of connectedness between people stimulate co-attending to the same objects, which subsequently facilitates the construction of common knowledge (Skorich & Haslam, 2022).

Crucial for the construction of collective attention is a fourth concept, the concept of *self-categorization* (Shteynberg et al., 2020). Self-categorization is described as 'a process that groups together social stimuli — other individuals, but also other representations of the self across situations and occasions (Skorich & Mavor, 2013) — in ways that result in a holistic, higher order, emergent understanding of the self and its relations with others' (Skorich & Haslam, 2022, p. 1376). It is the mechanism through which individuals use social categories such as age, gender or occupation, to make sense of social cues such as, jargon, traits or behaviors (Skorich & Mavor, 2013). Each social category contains understandings concerning behaviour, interactional norms and what is considered 'good' knowledge. Fitting behaviour, fitting ways of interacting and fitting knowledge in certain social contexts are inferred by the process of self-categorization, which facilitates and stimulates the construction of collective attention with members of that category (Srikanth et al., 2016). Although this seems a crucial phase for a beneficial use of individual diversity for collective learning, the processes in play between self-categorization and the construction of collective attention and common knowledge are not yet studied.

The self-categorization process can initiate the formation of a collective identity through collective attention and the subsequent development of common knowledge, transforming the self and others into a shared 'us' (Skorich & Haslam, 2022). This collective identity, once established, further facilitates collective attention and can evolve into a social category with which both the self and others can be categorized, once again providing a framework for collective attention. The process of collective learning is illustrated in Fig. 1.

Fig. 1 shows collective learning as an iterative, deeply connected

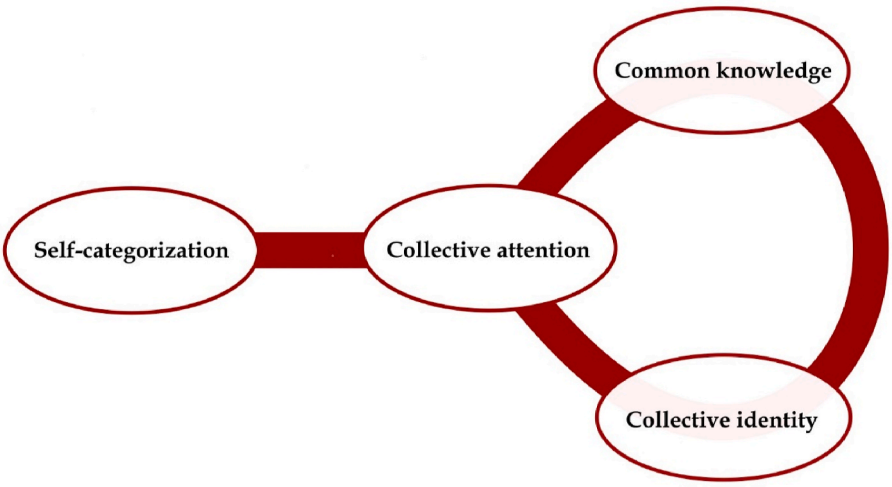

Fig. 1. The interplay between mechanisms that constitute collective learning.

process in which self-categorization facilitates collective attention, which triggers the construction of common knowledge, and the construction of a collective identity. And vice versa, the creation of common knowledge or collective identity stimulates collective attention and self-categorization (Fig. 1). Collective learning in this perspective is a process of collective identity construction (Wenger-Trayner et al., 2020), in which collective attention plays a crucial role (Shteynberg et al., 2020). Although this perspective offers an insight into the mechanisms of collective learning, there is little research on how this process occurs in professional development situations such as Professional Learning Communities. Understanding the mechanisms leading to collective attention and common knowledge in PLC functioning can, apart from more theoretical understanding of the collective learning process, contribute to designing effective learning environments and communities that promote collective learning.

3. Method

3.1. Design

To gain insight into the complex process of collective learning construction, a qualitative design by means of a multiple case study was chosen. Qualitative research provides the opportunity to examine specific phenomena in depth and to collect people's experiences and the meaning they attribute to these experiences (Yin, 2009). Eleven educational professionals were interviewed on their participation in two PLCs. These two PLCs formed two cases, facilitating the study of the complexities of this real life situation. To ensure richness of the data, a semi-structured interview format was used providing participants with ample opportunity to share their experiences and the meaning they attributed to them. This qualitative approach allowed both for an exploration of the concept of collective learning and for theory development concerning the collective learning construction process in PLCs (cf. Williams & Moser, 2019). To identify elements beyond those described in theory, a combined deductive and inductive coding approach was employed. This method allows for the confirmation of anticipated phenomena while also enabling the discovery of new, unanticipated ones (Lincoln et al., 2011; Yin, 2009).

3.2. Procedure

Two educational organizations, a teacher education institute for primary education and an educational consultancy organisation advising primary and secondary schools on educational matters, aimed at collaboratively constructing knowledge for educational innovation. In order to develop both practical and scientific knowledge, two PLCs were constructed based on empirical evidence of critical conditions derived from PLC research (Castelijns et al., 2013; Huffman et al., 2016; Vescio et al., 2008; Huijboom et al., 2021; Meeuwen et al., 2020), such as: organisational support, sufficient time and opportunities to meet and work together, a facilitator, equality, diversity among participants (expertise, proficiency level, workplace), collective autonomy, respect and trust.

In a start-up meeting, PLC participants were briefed on the conditions for successful PLC functioning. All participants got 80 h annual facilitated. One member in each PLC held the role of PLC-facilitator, who received 40 h more. A PLC facilitator was appointed, recommended by Huijboom et al. (2021), to stimulate reflection, feedback and experimentation between PLC participants. PLCs met on a monthly basis. The facilitators met on a two monthly basis with an expert for support on facilitating PLC development. Furthermore there was a short briefing of the learning focus of the PLCs by the management. The goal was twofold, speeding up the process of developing a collective ambition and aligning the PLCs with organisational policy. One PLC focussed on self-regulation of pupil learning (SR) and the other on the deep learning and its possibilities for everyday educational practice (DL). PLCs had been operating for six months when the interviews were conducted in April 2020, in order to capture participants' perspectives on the process of constructing collaborative learning within their PLC.

Before starting the PLC, PLC members were informed about the research and asked for consent, based on the procedure and approval of the ethical commission of the Dutch Open University, reference U202009418. The PLCs started with a start-up meeting, organized by researchers and both managements. Interviews were conducted through Microsoft Teams due to Covid19 measures. Before every interview ethical boundaries were addressed. Interviews took up 50–90 min. They were audio recorded using an external recorder and transcribed by hand.

3.3. Participants

The two PLCs started with six members each. One member participated in two PLCs, which made a total of eleven PLC-members. All PLC-members were interviewed. Table 1 provides an overview of all anonymized participants and their professions. Both PLCs consisted of three members of each organisation. Each PLC was formed with both novices and experts.

3.4. Instruments

To gain insight into how PLC members constructed collective

Table 1
Overview of PLC participants, their roles and professions.

	Name	PLC	Role	Profession
1	Debbie	1	Facilitator	Sr. lecturer
2	Paula	1	Participant	Educational consultant
3	Susan	1	Participant	Educational consultant
4	Mandy	1	Participant	Teacher trainer
5	Harriet	1	Participant	Teacher Trainer
6	Kristel	2 & 1	Participant	Educational consultant
7	Maurice	2	Facilitator	Sr. educational consultant
8	Fred	2	Participant	Teacher trainer
9	Karen	2	Participant	Educational consultant
10	Peter	2	Participant	Teacher trainer
11	Egbert	2	Participant	Teacher trainer

learning, concepts of the general definition of collective learning (cf. Burini & De Lillo, 2019; Castelijns et al., 2013; Heikkila & Gerlak, 2013; Mercer & Howe, 2012; Wenger et al., 2011) were used to guide our interview format. These concepts were *social configuration*, *shared goal*, *social process*, *joint activities* and *shared outcomes*. To facilitate interviewees to elaborate on these concepts, value creation interviews (Wenger et al., 2011) were conducted with a focus on aspirational and enabling value and the relation with the activities PLC members employed. Questions were asked both on individual experience and on the perceived collective experience of the interviewee. The interviews were semi-structured and guided by the format in Table 2, each corresponding to a value cycle (Wenger-Trayner, Wenger, & Wenger-Trayner, 2020). Interviewees were asked to elaborate on the relation between values to assess the social processes that lead to the created value.

3.5. Analyses

Analysis was performed using both a data-driven and a theory-driven approach, illustrated in Fig. 2. The combined inductive-deductive approach was based on Williams and Moser's (2019) coding procedure of open, axial and selective coding. Transcriptions were first divided into text segments concerning a single topic. All text segments were subsequently analysed. In the open coding phase, codes were constructed inductive in Atlas-Ti 9, based on words used by the respondents (such as 'sense making' or 'giving meaning', shared goal, ambition or direction), resulting in over 100 codes. Three interviews were open coded separately by two researchers and differences in coding were discussed until agreement was reached, using the consensus-coding approach (Gibbert & Ruigrok, 2010).

Table 2
Value creation cycles and guiding questions in interview format.

Collective learning	Value cycle	Guiding questions
Shared goal, Social process	Aspirational value	1. What did you hope to achieve in the PLC, individually and as a group?
Social configuration, Social process	Enabling value	2. What do you need to achieve these goals, individually and as a group?
Joint activities, Social process	Ground narrative	3. What activities with PLC members did you employ, individually and as a group?
Shared outcomes, Social process	Immediate value	4. How did you experience these activities, individually and as a group?
Shared outcomes, Social process	Potential value	5. What knowledge, instruments or insights did they bring you, individually and as a group?
Shared outcomes, Social process	Applied value	6. How did this influence your daily practice as an educational professional, individually and as a group?
Shared outcomes, Social process	Realized value	7. How did this affect you, your peers, your pupils or other stakeholders, individually and as a group?
Shared outcomes, Social process	Transformative value	8. What fundamental changes in perspectives (if any) did the PLC bring you, individually and as a group?

In the axial phase codes were recoded into more general categories which were discussed based on two other interviews, using again the consensus-coding approach (Gibbert & Ruigrok, 2010). After agreement was reached all data was recoded. In the selective phase, overarching themes and patterns were identified, reflecting the processes within the PLCs in the first seven months. After the selective phase, results were theory-driven interpreted using the mechanisms of collective attention, common knowledge, collective identity and self-categorization. Because the research question focusses on experiences leading to collective learning, the results of the two PLC cases are discussed together. Citations were used to illustrate what was found and clarify the perspectives and experiences of the participants.

4. Results

In analysing the interviews inductively four main themes and ten codes were distinguished (Table 3). A majority of the codes were mentioned by almost all PLC members. The four themes distinguished were divided into themes reflecting primarily individual processes and experiences (individual sense making and dealing with diversity) and reflecting primarily collective processes and experiences (creating communality and strive for a collective ambition).

4.1. Individual processes

Individual sense making could be characterized as an exploration of personal perspectives, but also as the search for how PLC members' personal perspectives could be aligned, both with those of other members as individuals, and with the social configuration, or collective, they aspired, as Karen illustrated:

> 'Well, my aim still is, we work in education because we want to make a difference for pupils. We educate teacher-trainees, but that should ultimately lead to improvement for pupils. So ultimately, our cooperation should also make a difference for children.'[Karen]

Others signalled a tension between their individual perspectives and values, and the alignment of these perspectives to a collective interest. Fred described this alignment as a balancing act in which he tried to align his own interests with the interests of the group. However pursuing the alignment of his personal perspectives to the collective, slowed the collective process down considerably. He therefor experienced his attempts to contribute as a choice between his personal need for understanding and the progress of constructing a collective perspective.

> 'But the question is whether the benefit lies in the progress or in the delay (…) but I do notice that it [discussing perspectives] slows things down significantly. So, you're always balancing between my personal interest and the interest of the group. It's always about finding a balance, and I don't think there is a clear path ahead of us, so to speak.'[Fred]

Dealing with diversity dealt with participants getting to know the other members, signalling and valuing the differences between them. These differences were subsequently overcome by actively searching for similarities between the participants and between the two organizations. Paula described what similarities she found in her relationships with fellow PLC members and what effect these similarities had:

> 'When I look at Harriet from the [teacher training institute], she often views things from an educational practice perspective, just like I do. We connect really well on that front. […] As for Susan, I don't interact with her very often because I also teach in another educational program, and so does she. However, both programs include

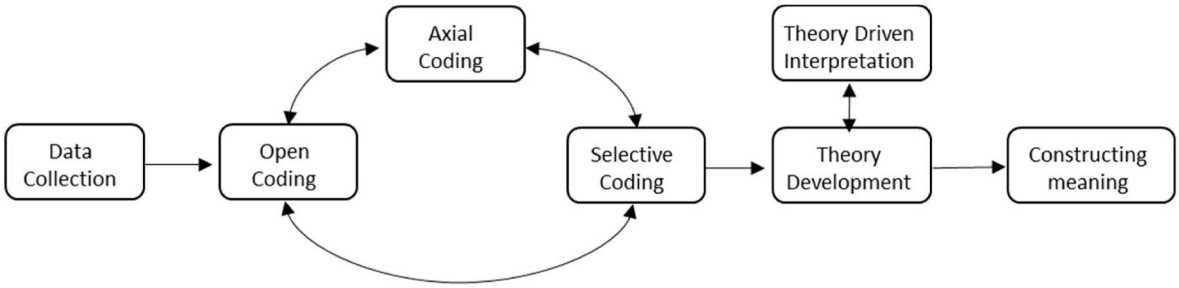

Fig. 2. Non-Linear Process of Qualitative Data Analysis
Note. This figure is based on Williams and Moser (2019).

Table 3
Overview of inductively constructed themes, frequency of units of analysis and reported by number of PLC members.

Themes	Codes	Frequency of units of analysis	Number of PLC members
Individual processes			
Sense making	Individual sense making	39	8
	Alignment sense making	60	10
Dealing with diversity	Signaling diversity	73	11
	Defining diversity	45	11
	Overcoming diversity	43	11
Collective processes			
Creating communality	Collective sense making	52	10
	Investing in communality	25	10
	Sense of communality	46	11
Strive for a collective ambition	Need for a collective ambition	47	10
	Creating a collective ambition	25	8

practice-based research, so we both approach things from a research perspective. We connect very well there as well.' [Paula]

The similarities Paula perceived with her fellow PLC members varied in nature; one was a shared perspective on educational practice, the other a shared perspective on practice research. Yet both were something that made them 'connect really well'. While the first similarity was described with some certainty, apparently based on the knowledge Paula actually had on Harriet, the second similarity appeared to be less solid. Paula described not to deal with Susan very often, due to logistical issues, suggesting that her knowledge of Susans perspectives was limited. However, because the program they both worked in contained practice research, Paula claimed to share a practice research perspective that made them connect very well. This attribution of similar perspectives to other participants, whether based on actual knowledge of them or not, resulted in a felt connection.

In the two individual themes, individual processes contributed to collective processes. The two individual processes, individual sense making and dealing with diversity, can be interpreted as *self-categorization*. Participants described the exploration of their personal beliefs and values and they attributed qualities to the other participants. By exploring social cues such as 'belonging to organization X' but also 'liking research' and 'knowing how to use literature' they cognitively accessed the social categories and adhering norms on knowledge, language and behaviour, the other participants belonged to in the eye of the perceiver, thus categorizing themselves and each other.

4.2. Collective processes

In the collective processes PLC members described *creating communality*. They jointly explored the topic at hand in a collective sense making process. This exploration was facilitated by the way they worked together. Using tools such as flaps and mind maps, both PLCs explored relevant educational concepts and constructed knowledge and beliefs to build on:

> 'We often worked with large flip charts, where someone would take notes and draw connections. (…) We also committed to reading literature in advance about understanding the concept and contributing our insights during the PLC meetings. That was very helpful. Additionally, we revisited the fundamental question of why: Why do we think it's important for children to self-regulate their learning? Why do we want that? Why do we strive for that? And going even further, why should that be a task for the PLC?' [Paula]

Paula described how they actively visualized their sense making process, using flaps. By explicitly externalising their discussion, participants stimulated and facilitated the creation of a shared perspective. In order to create this shared perspective, they agreed to individually collect knowledge, and to contribute this to the collective sense making process, actively and explicitly connecting the individual sense making process to the creation of a collective understanding. The answers to the fundamental 'why'-questions participants discussed, including the existential question on why it should be a matter for a PLC, aided in constructing the shared knowledge the PLC needed for working together. Intertwined in this process of collective sense making, participants described an emerging sense of communality, on both the need to work together and the willingness to working together.

Both PLCs *strived for a collective ambition*; to know where they were going and to know that they all knew where they were going. The wish or even need for something tangible was shared by all eleven participants:

> 'What we concluded was that you can discuss these things endlessly because there are always different angles or perspectives to explore. Since the topic is quite abstract, you often end up circling around it, trying to grasp something that isn't really there, so to speak. At some point, there was a need to shift towards concreteness and take tangible action.' [Fred]

While the collective discussion of their PLC topic contributed to their collective sense making process and added to their common knowledge, at some point, as Fred described, they concluded that the sense making process could go on without end, because true collective understanding was, at least at that point in time, not within their reach. So as a group, they expressed *the need for a collective ambition*. They explained this need using several arguments. They worried that theorizing for too long would distance them from their work fields. A concrete ambition would function as a bridge between theory and practice and would offer them as PLC participants the ability to explain to others what they discovered.

And, they signalled an effect on the PLC as well:

> 'When you begin to collaborate, it involves figuring out what to do and what it should lead to, and at some point, everything comes together. (…) And then, when you realize you're on the same page, it's really exciting because you no longer need to discuss it further. It's just, 'Okay, this is what we're going to do.'.' [Debbie]

The collective processes resulted in the construction of commonly shared knowledge, or common knowledge. This common knowledge concerned shared ways of working, but also shared perspectives on the topic of the PLC and shared beliefs concerning the need for good education. Common knowledge was constructed in instances of collective attention. These started with flaps to which PLC members literally co-attended, but their collective attention increased in complexity and abstraction, culminating in the construction of a collective ambition, something 'they didn't need to talk about anymore', since they all explicitly knew that this ambition was what they would collaborate on. All these processes worked towards constructing a collective identity of both being members of a PLG and of educational professionals working together towards a collective aim.

4.3. Attributing social equivalence

In the selective phase, patterns were distinguished and subsequently interpreted from a collective learning perspective. Apart from self-categorization to access appropriate social groups in order to establish collective attention, another mechanism could be distinguished in the alignment process between the individual participant and others. By aligning their own personal beliefs with those of the group and by actively overcoming the differences PLC members signalled between themselves and others, thus by searching for social similarities and equal values, they actively constructed *social equivalence* between themselves and others. Like Peter, who mentioned not knowing the other organization very well but attributed to them the same commitment to quality work as his own institution.

> 'I believe that we, as a [teacher education institute], are very modest, yet we strive for quality work. I think the [educational consultancy organization] shares this commitment. It's more like, 'We need to uphold our reputation,' but without arrogance. Although I don't know the [educational consultancy organization] very well, when I compare the two organizations, I feel that both aim to create something meaningful.' [Peter]

A commitment to quality work is a relatively generic trait. However, by articulating this perceived similarity, Peter created a shared belief for both organizations, positioning them as socially equivalent: two distinct entities unified by a common conviction about what is valuable and important. The belief he attributed to the other organization served as a bridge, directing their attention toward a shared goal: creating something meaningful. However, as Peter stated: 'Although I don't know the [educational consultancy organisation] very well, … '. The similarity between the two organizations was not something he had experienced but rather something he had constructed.

In the following Harriet explained how the social equivalence she signals in her PLC facilitates collective attention for the problem they aimed to solve:

> 'Everybody participates based on a passion for this problem and everyone has dealt with it in the past, either in research or in training educational professionals. We all studied this and we all want the same thing. And we all believe, and I think that that's important, we all believe that education can change by providing pupils with more ownership and by paying attention to what motivates children and how we can facilitate their learning […]. You have to believe that you're making children autonomous or that they are autonomous and that you guide them a little along the way and don't make them dependent on you. I think this is a belief we all share. I think that that is very important. [Harriet.]

Harriet described how she and her PLC shared a common aim: 'and we all want the same thing'. In addition she declares they all share a belief concerning the autonomy of children: 'And we all believe that education can change by providing pupils with more ownership … '. She stressed the importance of the fact that this belief is shared: 'And we all believe, I think that that's important, we all believe … '. She continued by 'You have to believe … ', indicating that this belief, she thinks is shared, is a necessity for achieving the aim the PLC set out to achieve. However, this description of the collective belief appears to be tentative, or so it seems in one of the final sentences, which she frames with a less sure 'I think': 'I think this is a belief we all share.'.

Harriet herself is convinced that a belief concerning the autonomy of children is necessary for achieving their common aim and attributed this belief to the other PLC participants. By making her fellow PLC participants into people who share her beliefs on autonomy, she constructed social equivalence: she and the others are the same in this respect. And being the same, being social equivalent as people who believe that children need to be autonomous, is fundamental for 'the same thing' they all want. This 'same thing', is the thing they were all attending to, the focal point of their collective attention.

The construction of social equivalence can be regarded as a mechanism between self-categorization and the construction of collective attention. PLC members categorized themselves and each other in social groups, yet signalled differences between themselves and other participants. They actively choose to value these differences as a source for learning and subsequently searched for similarities in perspectives or beliefs. The shared perspectives or beliefs that participants attributed to fellow PLC members, the entire group, or the organization to which others belonged seemed to be based on perceived similarities rather than actual, known similarities. These constructed shared perspectives and beliefs made them socially equivalent, fostering a sense of connectedness, which served as a foundation for collective attention.

5. Discussion

To answer the question 'How is collective learning constructed in professional learning communities composed of professionals with diverse educational backgrounds?' interviews with all members of two starting PLCs were analysed. The emerging themes from the interview data could be divided into those reflecting primarily individual (sense making and bridging diversity) and those reflecting primarily collective processes (creating communality and a collective ambition), and in all processes mechanisms were found that contributed to the construction of collective learning in the PLC. The four mechanisms that constitute collective learning—self-categorization, collective attention, common knowledge, and collective identity—were evident in the experiences of the PLC members. In addition to these mechanisms, a fifth mechanism, social equivalence, was observed.

Social equivalence is defined as the attribution of shared perspectives and beliefs, indicating that this equivalence may not be objectively real but is instead assumed or perceived. The attribution pertains to abstract beliefs, such as the pursuit of high-quality outcomes, rather than to concrete practices, such as specific actions or problem-solving methods. Social equivalence acts as a precursor to creating collective attention, as the belief in shared perspectives establishes an abstract common ground from which a collective ambition for guiding the PLC can emerge. This partially aligns with research on team development (Raes et al., 2015), where team members in the early phase of development base their behaviour on vague assumptions about group goals and stereotypes about how others will respond.

Fig. 3 shows the mechanisms involved in collective learning as a lemniscate. The shape illustrates the interplay between individual mechanisms on the left, the construction of collective attention at the

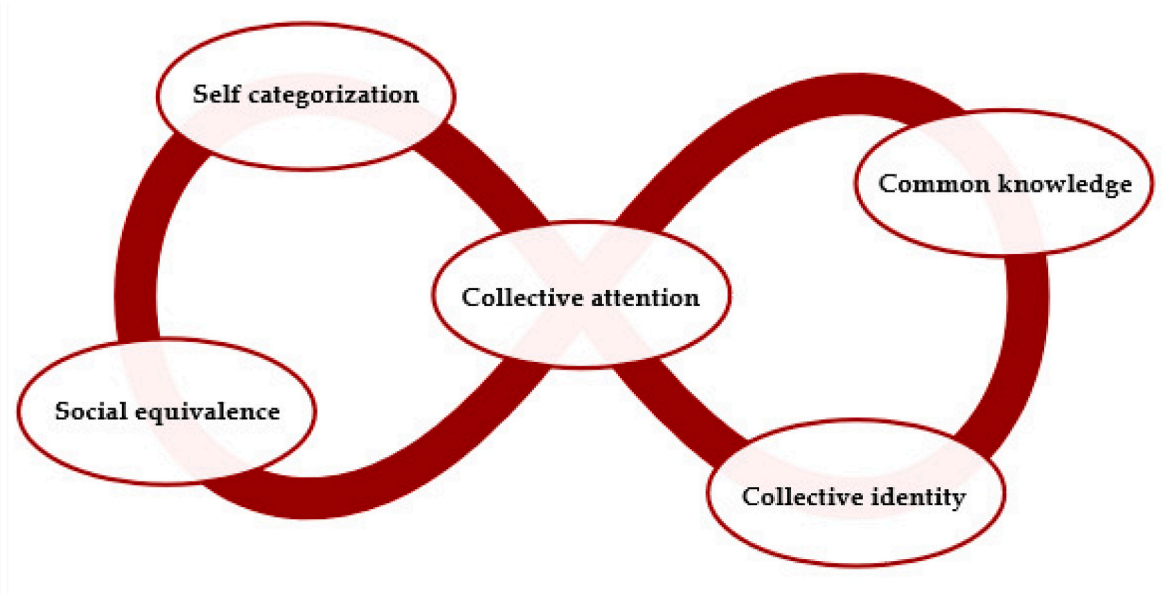

Fig. 3. Interplay between mechanisms of collective learning.

centre, and collective mechanisms on the right, operating in a continuous and iterative manner. The uninterrupted line represents the interconnectedness of the mechanisms and their reciprocal and continuous nature.

The interplay of these mechanisms constructed collective learning within the two PLCs. Through individual sense making and dealing with diversity participants engaged in self-categorization, which served as a starting point for constructing collective learning. Attributions of social equivalence regarding beliefs and perspectives of others acted as a facilitating factor for the development of collective attention. During the formation of the PLC, collective attention gradually became more abstract. Initially, it manifested as a shared focus on tangible items, such as flip charts, but eventually evolved into a collective focus on a shared goal. This goal can be understood both as a reflection of common knowledge and as a core component of their identity as a PLC, thus contributing to their collective identity. The development of common knowledge transitioned from individual perceptions of PLC functioning and relevant topics to a unified understanding of these topics and collaborative ways of working within the PLC. The emergence of a constructed sense of community among participants signalled the beginning of a shared collective identity, which, in turn, reinforced collective attention toward their shared goal.

The interplay between mechanisms can be understood as an iterative process, where each mechanism continuously influences and is influenced by the others. Consequently, the outcomes of these mechanisms become progressively more complex with each iteration. However, the iterative interaction between mechanisms not only leads to increasing complexity, but also introduces the possibility of failure at each stage. For instance in the following situation Paula described:

> 'I like it when everyone commits to the common goal. And when I notice that someone doesn't, that bothers me. And not because that person is different, but that their contribution is different. And when they do contribute, they act like they actually participate, and then I think: you should have stayed at home..' [Paula]

The person Paula described did not put in the work that was needed for common knowledge construction. She initially considered him social equivalent: 'not because that person is different'. However, his behaviour didn't align with Paula's perspective on what needed to be done in their collective work: 'their contribution is different'. She therefore constructed him as someone who pretended: 'act like they actually participate'. By attributing 'insincerity' to him, she no longer saw him as a social equal, which halted the iterations in the collective learning process between them: 'you should have stayed at home.'.

The attribution of social equivalence as a mechanism for collective learning can be compared to the process of constructing social relationships (cf. Nijland et al., 2023). The relationships people form are often based on similarities: individuals tend to connect with others who share similar backgrounds or perspectives, a phenomenon known as homophily (Pataraia et al., 2014). People prefer to engage with those who are similar to themselves. These similarities make it easier to engage in collective attention and to build common knowledge, as part of what is commonly known is already shared. Social equivalence, as a mechanism that facilitates collective attention, is supported by Skorich et al. (2017). They indicate that when a self-category is activated, individuals start to see themselves as equivalent to others within that category. However, this study indicated that when individuals feel the need to form a connection and similarities are not immediately apparent, they are capable of actively constructing them.

The attribution process implies that actual similarities are not truly necessary. As long as people believe that similarities are shared, attributed perspectives suffice for the construction of collective attention and common knowledge. The construction of social equivalence is supported by research on social perspective-taking (Lin et al., 2022; Wolgast & Oyserman, 2020), which refers to the ability to understand others' mental states. Social perspective-taking is enhanced by a collectivist mindset, which increases awareness of diverse perspectives, improving performance on tasks that require such understanding. Contextual factors that foster this mindset are roles, language, word use such as 'we' and 'us', and task structures, often present in Professional Learning Communities (PLCs). The attribution of social equivalence can be seen as part of a collectivist mindset, which stimulates individuals to perceive themselves as connected to others (Wolgast & Oyserman, 2020). In addition, this indicates a reciprocal relation between collective attention and social equivalence.

This phenomenon of attribution is echoed in other research on collective learning processes. For instance, the mere perception of co-attending with another individual in online avatar tasks has been shown to enhance recall memory (Shteynberg et al., 2020) and the idea of shared task perceptions leads to more efficient cooperation in teams (Gevers et al., 2020). The attribution of social equivalence implies that people are more or less able to choose who they feel similar to and on

what grounds. In a society that could benefit from more diverse liaisons between people to solve fundamental issues, it is a promising notion that we are to certain extend able to choose who we feel sufficiently similar to in order to construct a collective learning relationship.

5.1. Limitations and future research

As this study was limited to two PLCs the initial conclusions require further investigation for validation or refinement. Since the cognitive learning perspective on PLCs has not been previously applied in PLC research, a qualitative exploratory design was adopted. To determine whether this perspective can be generalized to explain collective learning in other learning contexts, additional methods, such as observations or meeting transcripts, should be employed. While interviews capture valuable individual perceptions, they offer only a limited view of the broader dynamics at play.

Furthermore, while our research design was appropriate for addressing the research question, it has certain limitations due to the small number of participants and the reliance on digital interviews for data collection. The coding process was carried out by two authors and approached as carefully, systematically, and transparently as possible. In cases of disagreement, consensus was reached through discussion, which sometimes necessitated revisiting the literature. Nonetheless, the coding process remains interpretative and intersubjective in nature.

Future research in the field of education could investigate the processes that occur beyond the initial phase of PLC development to gain a deeper understanding of how the collective learning lemniscate operates, the critical factors that influence it, and whether other elements become more significant over time. Additionally, integrating insights from diverse research fields could help establish a more comprehensive theoretical framework for understanding of collective learning within social systems. Such advancements would contribute to the development of practical knowledge aimed at promoting collective learning in real-world contexts. As this study focuses solely on the first six months of PLC functioning, it remains unclear whether, and how, increased collective attention fosters social equivalence and self-categorization. Further longitudinal research covering extended periods of PLC activity is needed to address these questions and provide deeper insights.

6. Conclusion

The strength of this article lies in its integration of two theoretical perspectives: learning as a social process, which emphasizes learning through becoming part of a community and developing a social identity, and learning as a cognitive process. By combining these perspectives, a more nuanced and comprehensive understanding of the processes involved in collective learning was achieved. The findings suggest that collective learning from a cognitive perspective can be observed in the functioning of PLCs within the educational field. This perspective enabled the identification of a novel mechanism, social equivalence, which provides deeper insights into the interaction between self-categorization and collective attention during the initial stages of PLC development. Social equivalence refers to the process through which PLC members attribute abstract similarities, such as shared values and norms, to their peers, rather than concrete similarities, such as performing identical tasks or achieving the same outcomes. These findings informed the development of a lemniscate model, which conceptualizes collective learning as a continuous, iterative process that can be disrupted at any point between its elements. Such disruptions may offer an explanation for why collective learning often fails to materialize. However, further research is needed to explore how this lemniscate model functions during the ongoing development of PLCs and to investigate whether it applies to other PLCs within education or across different fields.

CRediT authorship contribution statement

Femke Nijland: Writing – original draft, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Marjan Vermeulen:** Writing – review & editing, Project administration, Conceptualization, Resources, Methodology, Formal analysis.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT for language editing. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

One of the authors is affiliated to the two organizations that participated in this research.

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