‘What did you talk about?’

Teacher and students’ joint construction of subject-oriented meanings

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PART I: EXTENDED ABSTRACT

Chapter 1: Introduction

An important component of the schooling system's mission is to raise students into active citizenship. In order to keep democratic values alive, we need our students to become citizens who engage in society and participate in democratic processes (Doyle, 2015; Freire, 1970). Students need to acquire knowledge to make well-informed choices and judgements, but they also need to develop argumentation and reasoning skills. In classrooms, these skills, as well as an understanding of democratic values, can be developed through participation in dialogues that recognise both differences in positions and arguments and ideas of how consensus can be built (Mathé & Elstad, 2018; Reznitskaya & Wilkinson, 2015; Strømme & Furberg, 2015).

Participation in dialogues where different views are explored can also foster engagement for subject learning and deepen students' understanding of the topic (Engle & Conant, 2002; Reznitskaya & Gregory, 2013). This thesis discusses how teachers can let students experience that they, through engaging in classroom dialogues, can use their own voices to contribute to subject-oriented meaning-making. I argue that these experiences can influence students' understanding of democratic participation by enhancing their participatory agency. My hypothesis is that giving students the opportunity to engage in subject-oriented interactions at school will influence a) their understanding of how democracy works, b) their capacity to become participating citizens, and c) their learning processes.

Rooted in the sociocultural tradition, I view humans as inherently social. We learn through experiences, and we experience by engaging with the world around us. Through interaction, we gradually acquire knowledge of the world. In light of this, the human mind is social, even though mental action may be carried out in isolation (Wertsch, 1991). Mental or cognitive action involves interaction with the world and often comprise the use of tools, such as language or numbers. We develop cognitively through interactions with our social surroundings, and culture and society develop in an interdependent relationship with the individuals it comprises—society influences individuals and individuals form society (Säljö, 2010). This understanding of the relationship between culture, society, and individuals highlights the importance of educating students to become active citizens who are conscientious of their role in society and have the agency to enact this role.

One way of engaging students in classroom activities is through talk, and there is broad evidence supporting the notion that classroom talk can be productive for students' meaning-making (Alexander, 2012; Howe et al., 2019; Mercer et. al., 1999; Reznitskaya et al., 2001). Despite an increased focus on student active approaches in both educational research and teacher education (Brugha et al., 2018; Kim & Wilkinson, 2019), research shows that these approaches are still relatively rare in classroom practice (Park et al., 2017). In schools, engagement must be related to the subject taught in order to become productive for students' learning. For students to engage in subject teaching, they need to see that their engagement matters and has an impact in the classroom (Clark et al., 2016). I argue that to achieve this, it is crucial to let students become active participants in subject-oriented meaning-making, building new meanings from their voices. This assumption reflects a dialogic stance on teaching and learning and is at the core of this thesis. Influenced by dialogic thinkers (Bakhtin, 1986; Linell, 1998; Mercer & Littleton, 2007), I view meanings as situationally negotiated and constructed through interaction. By focusing on students' contributions to subject-oriented meaning-making, I hope to add to the knowledge on why and how classroom talk can contribute to students' learning.

Even though this thesis focuses on a dialogic approach to teaching, I do not mean that this approach should be the only way teachers teach or that student interaction and cooperation will always enhance learning. However, I hope that this thesis can provide some tools to help teachers facilitate interactions that are productive for learning. These tools are not intended to be applied all the time, only when the teaching goal is appropriate. For instance, when the teaching purpose is mainly to guide the students towards valid knowledge, an authoritative or monologic approach to teaching may be most efficient (Aguiar et al., 2010). The articles show that the strategies depicted in this thesis can encourage students' reflections, let them build new meanings on previous knowledge, and influence their agency and understanding of democracy positively. By pointing out strategies that can facilitate subject-oriented meaning-making through interactions in these ways, I hope to expand teachers' toolboxes by adding variation.

This thesis is part of the research project Digitalised Dialogues across the Curriculum (DiDiAC), which investigates the potential of dialogic teaching with the aid of a microblogging tool. The project is a collaboration between researchers at the University of Oslo and the University of Cambridge and 22 teachers in Norway and England. Technology has been shown to facilitate classroom dialogues (Gao et al., 2012; Thoms, 2012), and one of the central strategies investigated is the use of a microblogging tool to bring forward students' contributions. Microblogs and digital whiteboards can

initiate conversations and support collaborative learning and reflection (Major et al., 2018; Mercier et al., 2015). Microblogs have also been shown to open new opportunities for organising discussions, questions, and elaborations of students' contributions (Rasmussen & Hagen, 2015). In this thesis, the focus has been on how technology can be used as a tool to facilitate subject-oriented meaning-making.

Being part of the DiDiAC project gave me the advantage of close collaboration with experienced researchers and other PhDs. This cooperation has been invaluable for my learning processes. It also supplied some frames for the project with regard to design and topic—dialogic teaching and technology were central elements in the DiDiAC intervention. As further described in the methods section, being part of this project gave me access to a large body of rich empirical material. Although participating in an intervention study that introduced the teachers to dialogic approaches and strategies, how they appropriated these approaches varied in the material. I chose to focus my thesis on one particular teacher because her strategies stood out among the participating teachers. The researchers shared the observation of a classroom culture that supported dialogic interaction. The students participated to a large degree, and added important contributions to the classroom conversations.

I hypothesised that investigating this teacher's strategies would give me access to interactions that positively influenced students' learning through dialogue. Because I wanted to investigate teaching strategies that promoted dialogic teaching and how they influenced students' learning, I needed to gain thorough insight into the teacher's work and her classroom. In order to understand the interactional details and how they were related to their context, I needed to study a rich case in depth (Flyvbjerg, 2006; Yin, 2014). For this reason, I chose to focus on this one teacher alone. Through focused analyses, I accomplished two objectives. First, I was familiarised with the classroom culture, which allowed me to study recurring patterns and interactional strategies. Second, by combining these analyses with a detailed utterance-by-utterance analyses of the interactions, I was able to explain how and why these strategies worked.

I observed the teacher and her class over two periods, with video recordings, interviews, and formal and informal talks. The three articles that this thesis comprises follow this teacher and her students in social science. In the first article, we meet the class in 8th grade in secondary school. In the next two articles, we follow the class in 10th grade. The scope of this empirical material allowed me to study the evolvement of teaching practices and classroom culture.

When we know the benefits of dialogic teaching, it becomes important to support teachers with strategies that can help them transform abstract knowledge into specific classroom practices (Reznitskaya & Gregory, 2013). This thesis describes specific strategies that can help teachers facilitate classroom interactions that are productive for students' learning. Building on an extensive body of research on dialogic teaching (e.g., Alexander, 2008; Mercer & Littleton, 2007; Nystrand et al., 1997), the aim is to identify teaching strategies that actively engage students in subject-oriented meaning-making. My ambition is that this thesis can contribute to increasing the practice of teaching approaches that build on students' contributions, defining strategies that can be included in almost any subject teaching, and that do not require teachers to reorganise their practices from scratch. I argue that the strategies I put forward are adaptable to many subjects and teaching approaches.

To summarise, this thesis has two overarching aims:

1. Through analyses, identify teaching strategies that build on students' voices to achieve subject-oriented meaning-making.
2. To add to the knowledge on how dialogic teaching can contribute to students' learning by describing and explaining how and why these strategies can prove productive for students' learning

Outline of the thesis

This thesis is divided into two sections: the Extended Abstract (Section 1) and three empirical studies (Section 2). The purpose of the Extended Abstract is to account for the unity of the three studies that this thesis comprises, to describe the theoretical background and the methods applied in more detail, and to situate the findings within a knowledge domain. The Extended Abstract consists of seven chapters.

Following this introduction, Chapter 2 presents the theoretical background, where I give an account of sociocultural and dialogic perspectives on meaning-making and discuss these perspectives in light of epistemic stances. In Chapter 3, I first discuss some of the hallmarks of a selection of learning approaches relevant for a dialogic approach to teaching before I elaborate the reviews from the articles on how technology can be used to enhance classroom interactions. In Chapters 4 and 5, I elaborate on the methodological considerations of the studies. In Chapter 4, I describe the empirical material

and discuss the reasoning behind the selection before describing the analytical approaches in more detail. In Chapter 5, I discuss aspects related to reliability, validity, and ethical considerations. In Chapter 6, I give summaries of the articles before discussing the findings in Chapter 7.

Chapter 2: Theoretical perspectives

The research depicted in this thesis is theoretically informed by a sociocultural and dialogic approach to meaning-making (Bakhtin, 1986; Linell, 1998; Vygotsky, 1978; Wertsch, 1991). These perspectives have different origins. Sociocultural approaches originate in Russian learning psychology, while the source of dialogical perspectives is a wide range of disciplines covering linguistic and communicative traditions. The sociocultural approach describes how meaning is culturally constructed over time by human minds interacting with each other and the culture in which they take part (Wertsch, 1991). This approach explains how knowledge is communicated through different kinds of tools, and how such tools can be used to mediate knowledge. I use this approach to inform the cultural aspects of my analyses, and particularly to discuss mediation and the use of Talkwall. I use the dialogic approach to explain how meanings are made through interactional means. This approach is crucial for the analysis of the interactions. As I see them, these approaches are intertwined—culture is built through interactions, and interactions depend on the culture in which they take place. However, they allow for a slightly different focus of analysis, and in the work of this thesis, I have needed both. This thesis rests upon the idea that knowledge is developed through a process of joint construction (Bakhtin, 1986; Linell, 1998), dependent on the relationship between human mental processes and their cultural settings (Wertsch, 1991). In this chapter, I discuss how this assumption is at the core of both sociocultural and dialogic approaches. I situate my work in relation to these theoretical stances, and address epistemological assumptions they imply.

2.1 Tools, mediation and signs

Through the culture we are part of, we both inherit previously developed tools and influence tools to be used by others. Our culture develops through an interchange between situated interactions and historically developed tools. By interacting with our surroundings, we become part of this cultural development, and we learn by interacting with others and the tools around us. Through these interactions, we also influence others, and sometimes we add to the development of tools. In this way, our culture gradually develops through human interactions (Säljö, 2010; Wertsch, 1991). From this perspective, tools constitute historically developed knowledge that we inherit from previous generations. Such tools include everything from hammers and shovels, books, computers, and software to different languages. The way we use these varied tools shapes our actions in essential ways

(Wertsch, 1991); for example, our language shapes the way we speak, and the use of new technologies has changed workplaces immensely. Because the tools we use shape our actions to such an extent, we need to study them to understand our actions. Emphasising this aspect of tools, Wertsch (1991) referred to tools as *mediational means*. As Vygotsky (1978), he points to different examples, such as the typewriter, when explaining the role of mediation. In this thesis, I have used mediation referring both to the knowledge a tool transmits and to the task-specific aid a tool provides. These two operationalisings are intertwined, as the knowledge a tool transmits is inherent in the aid it provides.

Vygotsky showed us the special position *signs* have as tools (1978, p. 39). Of these, he saw language as the most important. By representing aspects of reality, signs mediate the world surrounding us, allowing us to compare, contrast, reflect, and reason. In this process, signs become tools we use to organise our understandings of the world (p. 54). Such tools include semiotic signs, but can be almost anything. Vygotsky (1978) further discussed mnemonic devices to exemplify mediation, which can be internalised (as strategies for remembering), or physical objects that make an individual remember through association.

The use of mediating signs grows in complexity as children grow older, and our understanding of the world becomes organised by the formations of concepts through which we systematise and sort our surroundings to categorise, make connections, and gain new insights (Vygotsky, 1986). Thus, our culturally developed language is key to knowledge. Vygotsky sees the development of language at the very core of learning, both as a tool and as an essential prerequisite, as through the tool of language, we are able to help each other learn. In this learning situation, Vygotsky highlights the importance of the differences between what a children can accomplish on their own, and what they may accomplish with guidance from an adult, a teacher, or a more experienced other. He described this as the zone of proximal development (1978, p. 89). In the empirical material in this thesis, the teacher guides her students in various ways. Vygotsky's concepts serve as principles for the analysis of her guiding strategies.

2.2 Interthinking and learning

Bringing Vygotsky's ideas into the classroom, Mercer (see Littleton & Mercer, 2013; Mercer, 2004; 2008; 2013; Mercer et al., 1999; Mercer & Littleton, 2007) has contributed to renewing the

sociocultural stance. One of the core concepts from his approach influencing this thesis is *interthinking*. Interthinking describes how people, through joint intellectual activity, can collectively use language to think together, make sense of experiences, and solve problems, thereby achieving more through working together than alone (Littleton & Mercer, 2013; Mercer, 2000). Through this interactional work, interlocutors create a *dialogic space* (Cook et al., 2019; Wegerif, 2010) where opinions can be explored. This space is widened when new arguments or topics are introduced and deepened when interlocutors increase their reflections by elaborating on the meaning of the arguments to better understand the topic (Baker et al., 2003).

In achieving interthinking, interlocutors' utterances become foundational resources, and the *coordination* of thought becomes fundamental (Barron, 2000; Linell, 1998). Coordination describes how interlocutors, to some degree, have to establish a mutually shared perspective or vantage point to understand each other (Linell, 1998). Barron (2000) described some hallmarks of coordination, showing how students in coordinated activities played complementary roles in completing problems. They referred to each other's ideas, constructed new ideas, monitored solutions jointly, and responded to each other's contributions (p. 429).

Building on Vygotsky's concept of internalisation, Mercer sought to explain why and how interthinking improved individuals' learning (Littleton & Mercer, 2013; Mercer, 2013). As Vygotsky, he regarded language and concepts as crucial tools in this process. He described three possible explanations that he regarded as complementary. By *appropriation,* he indicated how individuals could learn successful strategies from others and apply them in new situations later on. By *co-construction*, he indicated how individuals, through interthinking, could construct new strategies that were better than the strategies they could have constructed alone. Finally, he applied the term *transformation*, describing how cognitive strategies shared by students working in groups or dyads, if made explicit, could promote the student's metacognitive awareness of how they reasoned. This can serve as a model that students may use to perform intramental dialogues when faced with similar problems later (Mercer, 2013).

These explanations build on the notion that the way we use language to interthink influences the ways we think individually, which again influences the ways we use language in interactions with others (Wertsch, 1991). Mercer described this evolvement as a helix and emphasised the interdependence of the evolvement of the use of language and cognitive development. The analyses done in this thesis

resonate with Mercer's explanations of why and how interthinking can influence students' learning. However, my focus is limited to the classroom and subject-oriented meaning-making.

2.3 Dialogue and joint construction of meaning

Where Vygotsky studied how language becomes a central tool for learning, Bakhtin (1986) studied how we construct meaning through dialogues. I follow Linell's (1998) definition of dialogue as '*interaction through symbolic means by mutually co-present individuals'* (p. 10, italics are from the original text). In this context, symbolic means refers to the same phenomenon as Vygotsky's use of sign described in section 2.1. Bakhtin described how every utterance in a dialogic sequence must be interpreted with regard to both previous utterances and the anticipation of further utterances and thereby the anticipation of how your own utterances will be interpreted. 'Any concrete utterance is a link in the chain of speech communication of a particular sphere.' (p. 91). Therefor utterances can only be interpreted when the whole chain of utterances (both previous and those to come) is taken into account. As such, meaning cannot be reduced to either the utterance of the speaker or the interpretation of the listener but emerges from the context between them. Bakhtin (1981) used the term *inter-animation* about this aspect of language, describing that meaning emerges between the voices and not in a single voice alone. This implies that meaning must be constructed and reconstructed in particular situations.

By using language, signs, and other mediational means, we activate culturally created meanings immanent in the tools (Wertsch, 1991). In this way, our utterances reflect previous speakers and users, or in the words of Bakhtin: 'The word in language is half someone else's.' (1981, p. 239). According to this point of view, the world is essentially dialogic, because words carry within them the meaning constructed by the use of previous speakers, and by using language, we thus enter into a dialogue with the culture we are a part of (Bakhtin, 1986, p. 69). This view reflects the epistemological position that Linell (1998) termed *dialogism*, which I will discuss further in paragraph 2.6.

Bakhtin's research reflects his position as a literary scholar, and even though he wrote an essay on speech genres, his theoretical perspective is mainly based on written texts. Linell (1998, 2009) built on Bakhtin's work (among others), and with the benefit of having access to new tools such as tape and video recorders, developed a conceptual framework to analyse real live discussions. Building on

Bakhtin, Linell (1998) described the double process of dialogue as response-initiative or the janus-face of dialogue. Each utterance in a dialogic exchange reflects that the speaker is simultaneously responding to previous utterances and initiating further responses by the other. Thus, every utterance is at the same time linked to previous and future utterances, constituting both a response and an initiative projecting a possible continuation by the interlocutor. This resonates with other complexities of dialogic interaction: at the same time, the listener is trying to comprehend the speaker and prepare his own response (Yakobinsky, 1997).

Linell (1998) described how the speaker was thinking while talking, not having the whole utterance ready made before starting to speak. This makes the speaker's meaning-making only a little ahead of the listener's. These descriptions show how both the speaker and the listener are involved in the meaning-making. The aspects of dialogue described in this paragraph show how dialogic interaction constitutes a *joint construction* (Linell, 1998) in which meanings are situationally negotiated. The concepts of inter-animation, joint construction, and interthinking are closely related, and all describe different aspects of how meanings are negotiated and established through interactions. While inter-animation describes how meanings in dialogues emerge between utterances, joint construction describes how the interlocutors in dialogic activities construct meanings by engaging with each other's utterances. Interthinking points towards how individuals through joint efforts collectively can think together to solve problems and create new meanings. Vied together, these three concepts display how dialogic activities can be described as a continuum, moving from tension between utterances towards intentionally goal-oriented interactions.

Interactions do not always involve interthinking, coordination, and joint constructions of meanings. Sometimes the listener is not listening, and sometimes the speaker has actually prepared most of their utterance in advance. This can make interesting clues in the dialogue. Interruptions can constitute breaches in the initiative-response cycle, stopping one of the interlocutors' reflections (Goldberg, 1990). However, interlocutors can also use interruptions as a tool for interthinking, with one interlocutor continuing another's line of reasoning, confirming coordination (Nikulin, 2010). How interruptions can constitute a tool for meaning-making amongst peers is further discussed in Article II.

Negotiated meanings build upon *meaning potentials* (Linell, 1998) inherent in the concepts, utterances, and tools in question. Meaning potentials are historically and culturally constructed, but they also

depend upon the interlocutors' previous experiences (Linell, 1998; Säljö, 2010). This duality of meaning potentials points to the interdependence between the monologic aspects inherent in the concepts, and the preconceived understandings of the interlocutors. Through interactions, new meaning potentials are negotiated based on this duality. Meaning potentials can be situationally negotiated and defined, e.g., in a school context, where concepts often have specific meanings that are distinguished from their everyday meaning (Rødnes et al., 2021). Where Linell emphasised how interlocutors enter into interactions with concepts bearing meaning potentials, Mercer pointed to *common knowledge* as a source of mutual references upon which dialogic interaction rests (Littleton & Mercer, 2013). Common knowledge constitutes both knowledge acquired through shared history, generated in joint activities, and knowledge that is taken for granted that members of the community in question share, and which therefore does not need to be explained. Because the evolvement of meaning potentials and the establishment of common knowledge are processes that evolve over time, I have studied trajectories. In an educational setting, trajectories refer to learning paths and describe the processes and results of taking part in activities over time (Rasmussen, 2012).

2.4 Learning as subject-oriented meaning-making

There are many approaches to what constitutes learning. Watkins (2003, pp. 10–17) categorised three such approaches: being thought, individual sense-making, and building knowledge as part of doing things with others. Some cognitive theorists focus on learning as how people commit new information to memory (Green, 1996). For Vygotsky (1978), learning comprised the appropriation of external processes. Sociocultural approaches study learning as activity that happens through people's participation in socially constituted practices (Wertsch, 1991). Some such approaches have studied learning as 'changing patterns of participation in specific social practices within communities of practice' (Gee & Green, 1998, p. 147), and others as enculturation in a social group (Brown et al., 1989). While acknowledging all these approaches, viewing them as complementary, in this thesis, I limit my approach to learning. Influenced by Mercer and Littleton (2007), who describe their take as 'the way people learn to make sense of the world, become able to solve problems and—in school settings—take on new perspectives such as those inherent in science, mathematics, and other subjects' (p. 3), this thesis focuses on learning through interactions in a classroom context.

Linell (1998) regarded learning as a dynamic and dialogical sense-making process between interlocutors. Vygotsky (1987) distinguished between *sense* and *meaning*. He used sense referring to how we try to grasp the world surrounding us through our consciousness, associating sense with thought and inner speech. By meaning, he referred to a more fixed and stable point of reference, often associated with language, social speech, and grammatical categories. Even so, he emphasised that the meaning of words is not constant, but changes with different situations (Wertsch, 1991; 2000). Both meaning-making and sense-making have been used to refer to how individuals work to grasp the world surrounding them. In this thesis, I study how individuals, through the use of language, negotiate meanings in interactions, building on their pre-knowledge. Because I focus on the social aspect, I chose to use the term meaning-making. Concepts, constructs, and ideas the interlocutors bring into a situation come with meaning potentials dependent on the interlocutors' pre-knowledge and become re-contextualised through interactional negotiations. Thus, meaning is viewed as situational and culturally constructed.

This also applies to classrooms, where meanings are negotiated, building on the resources the students and the teacher bring into the situation, thus recontextualising the meaning in each situation. In the context of the classroom, meanings are negotiated among peers and between the teacher and students. In these situations, the teacher most often has a subject-oriented goal for the meaning-making. Not neglecting that learning can comprise much more than this, in this thesis, I have chosen to operationalise learning as subject-oriented meaning-making.

2.5 Agentic participation

Agentic participation can be viewed as a condition for dialogic meaning-making. Even though some research has shown that participating students do not learn more than those who do not participate (O'Connor et al., 2017), participation is a crucial factor for classroom dialogues. There would be no dialogue without student participation, and more student voices may add richness to the interactions by adding viewpoints, thus widening and deepening the dialogic space. Findings suggest that the probability of elaborated talk where reasoning occurs is higher when student participation increases (Sedlacek & Sedova, 2017). To participate, students need to have the agency to do so.

In this thesis, I conceptualise agency as the socioculturally mediated capacity to initiate action intentionally (Ahern, 2001; Giddens, 1984; Godwin & Potvin, 2017; McAdams, 2013). The understanding of agency, as reflected in this thesis, perceives the concept to comprise both situational factors and the individual's prior experiences, influencing the individual's sense of agency (Hilppö et al., 2016). As discussed, Linell (1998) showed how the meaning negotiated in a situation was influenced by related meanings negotiated by the participating individuals in previous situations, comprising culturally constructed meaning potentials. Similarly, I argue that both the situational context and the previously experienced contexts influencing it, influence the individual's sense of agency. In Article I, we discuss how teachers can facilitate classroom interactions that influence students' participatory agency in a positive way.

2.6 Epistemological approach

Epistemology describes how different academic domains justify claims as knowledge through particular warrants and means (Greene et al., 2016). In this thesis, I assume the epistemological approach that Linell (1998) labelled dialogism. As discussed, he argued that linguistic meanings are open potentials rather than fixed coded meanings while still acknowledging the notion of a common language. Dialogism is in opposition to monologistic views, where linguistic expressions are assumed to have one single semantic representation, and expressions are viewed as codes representing fixed meanings. Further, Linell (1998) described social constructionism as a variant of dialogism, where meaning is seen as constructed in an interplay between cultural knowledge and situated interpretations. Mercer's concept 'common knowledge' describes this cultural knowledge and its role in interactions (Littleton & Mercer, 2013).

The term epistemology describes theories of knowledge. How individuals differentiate between knowledge and guesses, doubts, and other kinds of mental representations or claims can be described as epistemic stances (Chinn et al., 2011; Greene et al., 2016). Kuhn (1991) separated how individuals take different epistemic stances into three categories. There are parallels between the stance she described as evaluative and dialogism (Reznitskaya & Gregory, 2013). Individuals that held such a stance denied the possibility of certain knowledge, and reflected the understanding that viewpoints can be compared and evaluated. At the core of the evaluative process laid their view of argument as a fundamental path to knowing (Kuhn, 1991). This is in accordance with dialogism, where meanings

are viewed as situationally negotiated. Another of the stances she described, absolutist, has similarities with monologism. Individuals holding an absolutist stance regarded expert knowledge as certain and absolute, and their own theories as unsusceptible to challenge. This stance coincides with monologism where meanings are viewed as fixed. As shown, what constitutes knowledge varies with epistemic stances. I use Greene et al.'s (2016) definition of *knowing* as 'a specific kind of epistemic stance, more restricted than believing, where the person has evaluated the evidence for the claim and judged it to be sufficient to treat the claim as knowledge, as opposed to opinion or conjecture' (p. 3).

Dialogism has implications for the applied method. If meanings are negotiated through interactions and are situationally constructed, we must study these interactions to explain how subject-oriented meanings are made in classrooms. However, classroom meaning-making needs to be related to subject topics. In curricula, these topics are sometimes defined by fixed meanings. Thus, balancing between a dialogic approach to meaning-making and the monologic approach represented in parts of curricula becomes an important part of analysing the interactions. This dilemma is central in Article II. Kuhn's empirical data showed that individuals, to some degree, changed their epistemic stances between topics. This is in concordance with Chinn et al. (2011), who argued that whether people believe that knowledge is universal or contextual changes between situations. Thus, epistemic stances are not static belief systems. Interactions often reflect these shifts, and can include both monologic/absolutist/universal and dialogic/evaluative/contextual epistemic stances. Epistemic stances have important implications for how teachers facilitate classroom dialogue (Wilkinson et al., 2017). For instance, with an evaluative epistemic stance, arguments become central in dialogic meaning-making. Linell (1998) explained the shifts between epistemic stances as follows:

> In conclusion, then, we argue that dialogism may subsume, rather than exclude, the possibility of explaining work undertaken within monologist models. There is no inherent contradiction in claiming that partly monological activities recur in our dialogically constituted world. Moreover, dialogical interactions can never have 'only' context-specific features; there are always tensions between stability and change, between decontextualizing and contextualizing forces. At the same time, what we have called 'monological activities' can never be entirely 'monological'; they are also bound to specific contexts, purposes, interests, concerns, and commitments. (p. 286).

These shifts between monological and dialogical aspects implies that when analysing classroom interactions, we need to consider that dialogic meaning-making often, or perhaps nearly always, is intertwined with monologic aspects.

2.7 Central concepts

In this chapter, I have tried to give a description of the theoretical foundation for the central concepts used in the articles. In this paragraph, I describe how these concepts are applied as tools in this thesis. The concept *meaning-making* has a particular position in this thesis. Having conceptualised learning as subject-oriented meaning-making, this becomes the core phenomenon I focus on when analysing the interactions. This is most heavily reflected in Articles II and III, whereas in Article I, the focus of the investigation is on an element that can be seen as a condition for the learning activities that facilitate meaning-making, namely, agentic participation.

In all the articles, I applied an evaluative epistemic stance in accordance with dialogism. I do not regard knowledge as certain, but situationally negotiated and dependent on argumentation and the interlocutors' re-contextualisation of culturally acquired common knowledge or learned meaning potentials. This stance concerns the findings of the articles. To what extent they are generalizable is discussed in Section 5.3.

As mentioned in Section 2.3, I follow Linell's (1998) definition of dialogue as 'interaction through symbolic means by mutually co-present individuals' (p. 10). The term dialogic is used as an adjective to describe interactions with an inherent aim towards mutual exploration of topics and co-construction of new understandings. Dialogic teaching is used to describe teaching that strives for this aim through dialogue. Dialogue refers to a mode of interaction, while dialogism describes an epistemic stance. Using these terms can be problematic because the concepts have often been treated as intertwined. Classroom dialogue has often been used to describe interactions in which knowledge is treated not as a given, but as something that can be explored and examined (i.e., Nystrand et al. 1997; Resnick et al., 2018). This use of the term leads to some analytical challenges because, as discussed, almost all interactions, in addition to dialogic aspects, also involve monologic aspects, where one or more interlocutors communicate knowledge of a topic as a fixed truth alongside the joint project. Often it is difficult (and unnecessary) to distinguish between these aspects—monologic contributions can be built upon and thus become a part of the joint meaning-making. Because distinguishing between these details has seldom been the focus of my investigations, and to avoid confusion, I have often chosen to use the term interaction instead of dialogue.

In Articles II and III, I use the term interthinking to describe processes where students (or students and teacher), through joint intellectual activity, collectively strived to use language to think together,

make sense of experiences, and solve problems. In these articles, I also discuss how the students achieved coordination by asking questions to check each other's understanding and by inviting repairs, interrupting, or referring and responding to each other's ideas. Thus, coordination became a tool for students to achieve interthinking. In this process, the students activated their pre-knowledge, and used common knowledge and the concepts' meaning potentials as resources for the interthinking. With these strategies, the students and teacher created new meanings through dialogic interactions.

I perceive agentic participation to be a condition for the above-mentioned interactions. Even though agency is only discussed in Article I, the active participation shown in Articles II and III also demonstrates the students' high sense of agency. For instance, the central interactional concepts discussed—interthinking, interruption, and querying—are all dependent on the students' agentic participation.

As semiotic and non-semiotic tools partly determine our interactions (Wertsch, 1991), analysing how these tools influence classroom meaning-making becomes essential. I have focused the analyses on specific interactional tools, which are described in the reviews of the articles. The teacher's use of different dialogic moves is discussed in all articles. In Article I, I focus particularly on positioning as a tool for acknowledging and building agency. In Article II, the students' interactional strategies for meaning-making were a focus, and interruptions, coordination, and interthinking became central concepts. In this article, I also focus on the teacher's strategies for joint meaning-making, where she involved the students in this meaning-making and guided them towards valid knowledge by synthesising previous utterances. To describe this, I applied the concept of guided interthinking. In Article III, querying is the interactional tool at the centre of the analyses, which shows particular connections between querying and coordination.

One of the most dominant tools analysed across the articles was Talkwall, a tool that has both semiotic and non-semiotic functions. As a tool for organising classroom activities and mediating the transition of students' contributions from group to whole-class interaction, it constitutes a non-semiotic tool. However, when filled with contributions and used as a placeholder for ideas or as a starting point for new discussions, it constitutes a powerful semiotic tool.

By applying a sociocultural and dialogic stance towards meaning-making, I have entered into a dialogue with researchers and theoretical thinkers who have previously discussed the described concepts. These

concepts have been invaluable means for the meaning-making undertaken in this thesis. By entering into a dialogue between culturally built meanings and empirical material, I hope to add to our culturally developed knowledge by recontextualising these concepts.

Chapter 3: Review

In this review, I aim to describe aspects of previous research that are not discussed in the articles but are of relevance for the across findings. First, I discuss approaches in which building meanings from students' contributions is a central strategy. Second, I will focus on research on how technology can be used to mediate dialogic interactions in classrooms, as this has only been briefly reviewed in the articles.

3.1 Subject-oriented meaning-making building on students' contributions

In the review of the articles, I focused on how research has discussed concepts or specific strategies for teaching and learning. Here, I will discuss some of the hallmarks of a selection of teaching and learning approaches. In this way, I hope to establish a ground for comparing the analysed strategies of the teacher as they emerge across the articles to other approaches. I have chosen to focus on some central approaches that are embedded in sociocultural theories and that discuss problems similar to those I discuss in the three articles. In the following, I will give a short account of some of the reasons previous research has found why building on students' contributions may enhance learning before I give a review of the selected approaches.

3.1.1 Why building on students' contributions may enhance learning

Research shows that learning deepens when new information is related to previous knowledge and experiences (Barton & Tan, 2008; Moje et al., 2004). This may be explained cognitively by the need to generate relations between information stored in long-term memory and new information (Wittrock, 1990; Wittrock & Alesandrini, 1990), but it can also be explained socially. Students' agency to participate may strengthen when they experience that their pre-knowledge is recognised in class (Clarke, et al., 2016). Letting students explore topics building on their previous understanding has also been shown to foster engagement (Engle & Conant, 2002). Similarly, Nystrand et al. (1997) pointed to classroom dialogue as one way to foster engagement with academic content because through the process of dialogue, knowledge is 'generated, constructed, indeed co-constructed in collaboration with others. Students figure out, not just remember' (p. 17).

Scott et al. (2006) argued that by letting students root their building of new understanding in previous knowledge through dialogue, the teacher could motivate them by opening up the problem and

exploring their views. Similarly, research has shown that dialogic interaction can support subject-oriented explorations, because they open for discussing different views and understandings (Reznitskaya et al., 2009; Rødnes et al., 2021), also those that may be conceived as 'wrong' (Gresalfi et al., 2009). Furthermore, Anderson et al. (2001) argued that the ability to internalise thinking, in which we regard topics from multiple perspectives, emanates from discussions with interlocutors holding different perspectives. This is in line with Mercer's (2013) argument that interlocutors, by participating in dialogues, can appropriate thinking strategies used by others (see Section 2.2).

Russ and Berland (2019) argued for letting students construct solutions on their own rather than teaching established scientific truths, because the reasoning skills learned during knowledge construction created new intellectual tools, and thus, were more valuable than getting the answer right. To prioritise reasoning skills over established knowledge is also supported by the finding that strict instruction might support pseudo-transactional communication that leads to learned patterns of interactions instead of new reasoning (Berland & McNeill, 2012). In support of this, we know that students can establish shared knowledge by using their everyday language as a tool to gain a new understanding (Roschelle, 1992). When we know the extent to which building on previous knowledge can be productive for students' learning, it becomes important for teachers to have strategies to facilitate interactions in which this can take place. In the next section, I discuss approaches that have explored such strategies.

3.1.2 The Thinking Together Project

Aspects of the Thinking Together Project (https://thinkingtogether.educ.cam.ac.uk/) are described in the review of all three articles, so I will only give a brief account here. A central goal is to teach students *exploratory talk* (see Articles II and III). A central strategy for achieving such talk is the development of ground rules for talk, which are a set of local norms for conversations (Edvards & Mercer, 1987). To function as a tool for classroom dialogues, the students and the teacher need to agree upon ground rules that should guide the classroom conversations (i.e., 'We will take turns to talk and listen', or 'We will try to reach a shared agreement'). In the Thinking Together Project, teaching students to reason and interthink are central aims, and students' contributions become tools to explore topics with the goal for students to reach an agreement. In Article III, I discuss whether reaching an agreement is necessarily beneficial to students' learning.

3.1.3 Accountable talk

Accountable talk (Resnick et al., 2018) has many similarities with the Thinking Together approach, and also advises the establishment of norms for discussion (Kuhn & Zillmer, 2015). Amongst others inspired by Reznitskaya et al. (2009), the approach emphasises the importance of building discussions on students' ideas and argumentation, focusing on the process of understanding problems and thus, the importance of providing students with time to solve them. A suggested strategy is to structure student participation by assigning roles within the discussion task, such as a summariser or evaluator (Resnick et al., 2018). Eliciting and exploring different viewpoints to explore and understand demanding tasks are other central strategies. A key to this process is valuing all students' contributions, also wrong ideas, as this promotes student participation and has value in the process of exploration (Clarke et al., 2016; Gresalfi et al., 2009).

Tasks should be cognitively demanding and open-ended (without a single right answer) so that they require students to reason, explain, and elaborate in order to come up with solutions (Michaels et al., 2010). Metatalk about reasoning is encouraged, and the teacher should teach students to find and justify sources, as well as model argumentation (Resnick et al., 2018). Other central strategies advocated by this approach are the *talk moves* suggested by Michaels and O'Connor (2015). These are interactional moves teachers may use to orchestrate subject-oriented discussions that are productive for students' learning. They can consist of utterances that invite repairs or more extensive answers (e.g., 'Can you say more?' and 'Can you give us an example?') or press for reasoning by asking for justifications (e.g., 'Why do you think that?').

3.1.4 Community of learners

Brown and Campione (1998) suggested building a *community of learners* where the students undertook collaborative research, designed their own learning, and created their own curriculum. They focused on supporting sustained inquiry on a topic over time, making the students responsible for what they had learned and for teaching each other. Central methods they used to achieve this were *reciprocal teaching* and the *jigsaw method*. Reciprocal teaching focused on discussing texts in groups, where the participants took turns leading the talk. The 'leader' was responsible for initiating by asking a question, as well as summarising what had been read. When it became the teachers' turn, their role was to model mature versions of the strategies. In the jigsaw method, the students were first positioned as experts on specific topics, and then given responsibility for teaching others. Engle and Conant (2002) built on

Brown and Campione's work, arguing that students need to be given authority in addressing intellectual problems, as well as be made accountable and given sufficient resources.

3.1.5 Knowledge building

Inspired by Brown and Campione, as well as inquiry learning, Computer Supported Intentional Learning Environments (CSILE) was developed. The aim was to reconstruct classroom discourse to give priority to progressive inquiry, where the goal was to build collective knowledge (Scardamalia & Bereiter, 1996). By letting students build their own databases of problems and findings, where they also built on each other's contributions, they put the students' problems, arguments, and evaluations at the centre of classroom actions (Scardamalia & Bereiter, 1999). Based on these experiences, Scardamalia and Bereiter (2003) developed a theory of knowledge-building environments, which describes a learning situation in which students build knowledge in collaboration by considering ideas in regard to their strengths, weaknesses, applications, and potential for further development. The focus is on the strategies used in the process rather than the outcome, and central to the approach is building a classroom culture in which students engage in problem-centred inquiry and build explanatory knowledge (Chan et al., 2012; Hakkarainen, 2003).

3.1.6 Epistemic implications

Both Accountable talk and the Thinking Together Project advocate strategies that promote subject-oriented meaning-making among students and students' reasoning. Practising such skills is at the core of developing an evaluative epistemic stance. Accountable talk focuses on open-ended tasks to a greater extent than the Thinking Together Project, which seems preferable in regard to promoting an evaluative epistemic stance. Furthermore, the talk moves advocated by the accountable talk approach may enhance an evaluative epistemic stance in the way that they teach students to come up with reasons for their arguments. These moves are dependent on teacher involvement and can be perceived as the teacher guiding towards a predefined answer.

Both when practising knowledge building and in a community of learners, the students became responsible for subject-oriented meaning-making to a larger extent than in the other previously mentioned approaches. Not only were meanings built from students' contributions, but the students also became responsible for bringing content from texts and other media into the investigation and thus developing subject-oriented knowledge. In these approaches, the students' arguments and

contributions became the core of subject teaching, promoting an evaluative epistemic stance to a large extent. Students learned how their arguments and reasoning could be used to build content knowledge.

3.2. Using technology to bring students' contributions forward

Thus far, I have discussed strategies that build on students' contributions in subject-oriented meaning-making in classrooms. Section 3.1 describes some research approaches in which this has been central. In this section, I will discuss research that has studied how technology can mediate this process. Because the project this thesis is part of (DiDiAC) has developed and studied the use of a tool that combines the affordances of interactional whiteboards and microblogging tools with a dialogic approach to teaching, I will focus on central studies investigating the use of these tools. I did not include studies earlier than 2005 because the technologies used have developed a lot since then. Even though some principles may still be applicable, later studies are more relevant. I have also not included studies conducted on preschool children because the applied educational principles are quite different from those that are relevant for my studies.

3.2.1 Microblogging tools

Microblogging tools have been found to be useful in orchestrating classroom activities. They can initiate conversations and support collaborative learning and reflection (Gao et al., 2012). Mercier et al. (2015) showed that Twitter can increase on-task group talk and serve as a tool for teachers to orchestrate classroom dialogues. In traditional organisation of classrooms, teachers usually do most of the talking and students are supposed to listen. Because microblogs can display students' ideas dynamically (Rasmussen & Hagen, 2015) and give teachers insight into group talk (Mercier et al., 2015), they open up the possibility of getting responses from all students, instead of only a few. In this way, microblogs have been found useful for teachers to pick up on students' activities (Rasmussen & Hagen, 2015) and misconceptions (Mercier et al., 2015). By displaying students' ideas, microblogs can bring in new information (Thoms, 2012) and prompt exposure to alternative perspectives (Major et al., 2018). Looi et al. (2010) found that a tool similar to microblogging led to activities where students took active roles in analysing information, interacting with peers and teachers, solving problems, and designing solutions. By building on students' microblogs, the teacher can use students' ideas as points of departure in whole-class discussions (Rasmussen & Hagen, 2015).

Microblogging tools have been found to change participation structures in learning activities by allowing immediate and wide participation. Ebner et al. (2010) found that when a microblogging tool was incorporated into learning activities, students participated at a higher level than they would normally do. Furthermore, microblogging tools can help participants overcome hindrances, such as nervousness about asking questions (Gao et al., 2012), and students can benefit from being able to post their responses without the fear of discouraging or negative feedback from the class (Looi et al., 2010). This enhanced participation has been found to lead to a culture of engagement that also deepens students' interpersonal connections (Junco et al., 2011). However, active participation seems to depend on how the tool is used. Perifanou (2009) found that students participated actively in microblogging activities when they were invited to contribute and share information and resources, while others found that they did not when the tool was used to post information from instructors (Lowe & Laffey, 2011).

3.2.2 Interactive whiteboards

Interactive whiteboards (IWB) can serve as visualisations (Warwick et al., 2020) displaying different ideas, and thus facilitate joint attention to shared texts in classrooms (Mercer et al., 2010). In this way, IWBs can be used to mediate students' exploration of and challenges to each other's ideas (Kerawalla et al., 2013). By providing a base for further discussions and sustaining engagement (Gillen et al., 2007; Rasmussen & Hagen, 2015), IWBs can support a dialogic approach to knowledge construction (Deaney et al., 2009; Mercer et al., 2019). Deaney et al. (2009) found that these effects were corroborated by pupil reports that showed how the students found classes where they used IWBs to be more social and engaging. In particular, students placed value on opportunities to share ideas. Used in these ways, IWBs can create a dialogic space for sharing ideas and joint construction of knowledge (Mercer et al., 2019), and thus expand learners' participation and higher-order thinking skills, influencing curriculum delivery and learning (De Silva et al., 2016).

As with microblogging tools, it is important to emphasise that how the teacher uses the IWB is crucial to make its use productive for student learning (Mercer et al., 2010; Warwick et al., 2011). Research has pointed to teachers' efforts to create contexts for learning in which students can share knowledge and challenge each other's ideas as an important condition (Kerawalla et al., 2013; Kershner et al., 2010). Such contexts can be promoted through scaffolding strategies and the use of ground rules for conversation and collaborative reasoning (Kershner et al., 2010; Mercer et al., 2010).

3.2.3 Combining the tools

As mentioned, this thesis is part of a project that studies the use of a tool that combines the affordances of interactional whiteboards and microblogging tools with a dialogic approach to teaching (DiDiAC). An illustration of Talkwall is given in Section 4.1 (Fig. 1). Findings from articles published in this study show how combining these tools can add conditions that are productive for students' learning. These articles have been published in parallel with the work done in this thesis, and some of the findings overlap.

The findings show how the use of Talkwall can lead to group interactions that are productive for students' learning in different ways. By sharing the posts on an IWB, the utterances were given permanence. In this way, the students were made accountable for the peer interaction, and the teacher gained insight into the group talk (Rødnes et al., 2021). This use also gave visual support to the conversation (Frøytlog & Rasmussen, 2020). Furthermore, Talkwall was found to focus group talk by serving as a locus of attention that encouraged dialogic interactions, assisting collective knowledge building (Warwick, et al., 2020). When the tool was used in this way, connecting whole-class dialogues and group activities, students could enter the dialogue with a conceptualisation of themselves as part of a group effort, and meaning-making emerged through triangular interactions between the teacher, students, and Talkwall (Warwick et al., 2020). Because the students' contributions were made the object of the subsequent whole-class talk as a shared object of inquiry (Frøytlog & Rasmussen, 2020), the students' ideas transcended the groups (Rødnes et al., 2021). Such use of Talkwall was, amongst other findings, found productive in the co-construction of ground rules for talk (Rasmussen et al., 2020).

The use of Talkwall has also been found to expand dialogic space (Warwick et al., 2020). Because Talkwall allowed insight into other groups' ideas, thus exposing them to a wider range of ideas than conventional groups, Talkwall facilitated the widening of the dialogic space. Students also questioned other groups' contributions, and the selection of others' contributions caused disagreement between the group members, leading to interactions that deepened the dialogic space (Warwick et al., 2020).

Confirming research on microblogging and IWBs, the findings from the DiDiAC project also emphasise the teachers' organising work. Use of Talkwall did not necessarily prove productive for students' learning. The size of the contribution feed sometimes inhibited exploratory talk, as the teacher's desire to address all contributions often reduced discussions. Also, when students were

browsing the feed, they sometimes chose to ignore relevant contributions because the computer did not command the same level of respect as human interlocutors (Cook et al., 2019).

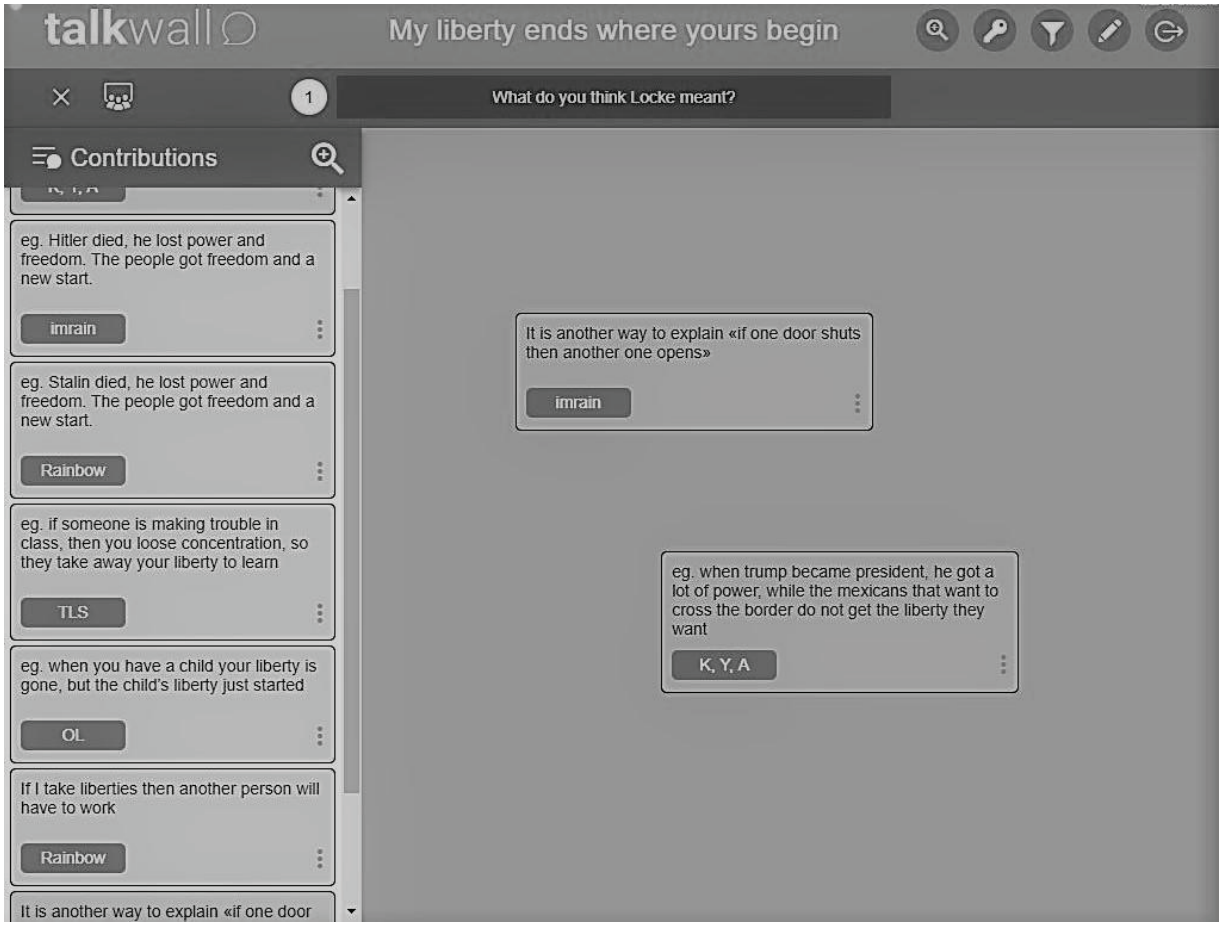
These combined studies show how Talkwall and other technological tools can constitute powerful mediational means in promoting subject-oriented meaning-making by expanding the dialogic space and allowing more voices into the classroom interactions. Constituting historically developed meaning potentials, comprising both technological affordances and—as in the example of Talkwall—previous knowledge on how technology can support classroom interactions, such tools mediate interactions. How these meaning potentials are realised depends on the unfolding interactions. This thesis investigates this process.

Chapter 4: Methods

4.1 The DiDiAC-intervention

The DiDiAC project, of which this thesis is a part, draws on design-based research (DBR) principles. This methodology originated from experimental researchers experiencing limitations with their method when studying classroom settings due to the lack of context (Barab & Squire, 2004). Because experimental designs were strictly limited in time, took place in a laboratorial setting and not in classrooms, typically with a one-on-one relation, not teacher-class, they concluded that to study educational issues, they needed to study real-life environments and not controlled experimental settings (Brown, 1992). Analysing learning processes and their outcomes, Brown's unit of analysis was the individual. Rooted in the sociocultural tradition, I study learning trajectories. Consequently, my unit of analysis is mediated actions over time (Krange & Ludvigsen, 2009), and the context influencing the interactions is taken into account. Following Krange and Ludvigsen (2009), my focus of analysis is not on the outcome of the intervention. Instead, the focus is on the project initiated through the intervention, and the processes to which this initiation led. I study interactions showing the uptake of the intervention, not outcomes. This analytical approach is shared by the researchers participating in DiDiAC, and distinguishes this project from traditional DBR, as described by Ann Brown and her followers.

DiDiAC investigates the development of new digitalised practices in the classroom, where the potential of dialogue-based teaching is explored. The intervention is grounded in a collaborative partnership (Lund, et al., 2009) between researchers, teachers, and technology developers. In cooperation, this partnership developed Talkwall (see Fig. 1), a digital whiteboard designed with the intention to enhance dialogic activities in groups, between groups, and between the teacher and groups. The design principles of Talkwall are discussed in Article II, Appendix A.



↑ ↑

Feed—shows all contributions made by the participants.

Wall—displays the contributions participant has selected from the feed. The participant can move or unpin the contributions.

Fig. 1: Reconstruction of Talkwall

Throughout the academic year of 2016/2017, an intervention where the continuous development and use of Talkwall and ground rules in teaching took place. This intervention evolved during the research trajectory in an iterative process with preliminary analysis of the data (cf. Collins, 2004). Empirical material was gathered in the form of video observations, field notes, digital logs from Talkwall, recorded meetings between teachers and researchers, and interviews with teachers and pupils at four different schools in the Eastern part of Norway and two in England. Autumn of 2016 was dedicated to doing pre-intervention recordings of one lesson from each teacher, having workshops and discussing dialogic approaches with the teachers. In spring 2017, three lessons were video recorded with each teacher, with the intention that they use Talkwall combined with a dialogic approach to

teaching. Before these recordings, every class had developed its own ground rules (Edwards & Mercer, 1987). Between each recording, researchers and teachers met to discuss the previous lesson and the plan for the next, as well as the use of Talkwall and teaching strategies. These meetings were recorded and enhanced the cooperative aspect of the intervention.

Collins et al. (2004) pointed to some fundamental limitations of DBR: the large amount of data may lead to data reduction problems and be extremely time-consuming, and the involvement of many participants needs to be coordinated. In the DiDiAC project, we met the first of these challenges by cooperating and agreeing to focus on different aspects of the study. An article presenting the findings across these areas are in process (Rasmussen et al., in process). The DBR-approach has also been criticised for not being truly methodological, and lacking in argumentative grammar (Kelly, 2004; Sandoval, 2014) 'that guides the use of a method and that supports the reasoning about its data' (Kelly, 2004, p. 118). This criticism was directed towards traditional DBR. In this thesis, I address these objections by applying the methodological approaches suggested by Krange and Ludvigsen (2009). Through applying such qualitative approaches, I study the processes of the intervention, not the outcome.

Even though this thesis focuses only on a small part of the empirical material gathered in the DiDiAC intervention, this does not mean that the research depicted in this thesis has not benefited from being part of a larger project. Having access to this rich empirical material meant getting insight into a broad range of teachers' practices, and having the possibility to study them in depth. This made it possible for me to make a reasoned choice when choosing to study one particular teacher. Taking part in the discussions of other's approaches, viewing empirical material that other researchers have focused on, reading other's article drafts, and having others commenting on my drafts and excerpts has greatly enhanced my understanding of the phenomena I have studied.

4.2 A teacher and her class – narrowing the material down to a case study

Being part of the DiDiAC intervention gave me access to rich empirical data, so I could have chosen a wider approach to studying the phenomena in question, for example, by comparing different teachers' practices and approaches. Instead, I chose to conduct a case study of one of the teachers. A case is a phenomenon that is specific to time and space. According to Yin (2014), a case study

'investigates a contemporary phenomenon (the 'case') in its real-world context' (p. 2). Through in-depth analysis and detailed examination, case studies allow the exploration of a case, a particular event, or a bounded system over time (Creswell & Poth, 2016). Case study research allows for investigating the characteristics of authentic events and complex and social phenomena. It can be iterative in nature and is used to develop theories for poorly defined phenomena (Yin, 2014). Typically, the problems examined are open-ended. The goal of case study research is to gain knowledge of the whole by focusing on a key part (Yin, 2014). Because case studies have an advantage in that they study phenomena in context, choosing to do a case study allowed me to investigate notions about the studied phenomena as they unfolded in practice (Flyvbjerg, 2006).

Orienting in a large body of gathered empirical material can be overwhelming, as confirmed by Collins et al. (2004). However, being part of a group of researchers meant learning from others and studying material from different angles. During the intervention conducted in spring 2017, the researchers from the group cooperated in recording classes. I participated in recording lessons from four teachers in two of the schools. At least two researchers were present in each lesson, and each teacher was observed by several researchers. We also watched selected episodes and discussed them in weekly research meetings. In this process, one of the teachers stood out in her practice of a dialogic approach and her use of the technology. The researchers who had observed her agreed on this impression and that her students showed active participation. I was particularly curious to investigate her way of acknowledging her students. Through the informal talk we shared with her before and after the recordings, she showed how her investment in the students extended the lessons. On the background of this shared initial impression, I chose to focus on doing a case study (Yin, 2014) of her teaching practices.

Studying the lessons recorded with this teacher drew attention to several issues that we wanted to investigate further. One of them I discussed in the first article. Another is discussed in an article by my supervisor (Rødnes et al., 2021). At this point in the research process, I had not decided how to proceed after writing the first article. There were several possibilities: I could compare this teacher's strategies with other teachers in the gathered material, or I could follow the plan from my thesis proposal and write about literature discussions. In the end, I decided to record more material with this teacher for a number of reasons.

The work in the first article confirmed the impression that this teacher practised strategies that positioned the students' contributions as central to the learning processes. I wanted to investigate the interactional details of these strategies further. I also wanted to investigate how Talkwall could be used within a learning trajectory when the teacher saw fit. In the recorded lessons from the intervention, the use of Talkwall was agreed upon as part of the research design. Furthermore, I wanted to follow a longer learning trajectory to better study how the students' subject-oriented meaning-making evolved over time.

To investigate these questions, I video recorded a trajectory of eight lessons in social science during autumn 2018 in cooperation with my main supervisor and a research assistant. We generally followed the design principle from the original intervention, discussing the lesson plan with the teacher before we started the video recordings and during the recording period. We also had a meeting with the teacher after the recordings to discuss the trajectory, and we conducted interviews with focus groups of students.

4.3 Empirical material

The empirical material relevant for this case study consists of video recordings from the observed lessons, and sound recordings from interviews with the teacher and students, and the research meetings between the recordings. We also have logs from Talkwall showing all the activities on this platform. An overview of the empirical material recorded with the teacher is given in Figure 2. The column named 'Recorded lesson' shows how many minutes of classroom interaction were recorded on each date. I started to participate in the recordings in spring 2017. I used the recording and notes for autumn 2016 to gain an impression of the teachers' practice before she participated in the DiDiAC intervention. 'Logs from Talkwall' refers to digital logs from the Talkwall activity that took place in the lesson in question. If a lesson does not have a log, it means that Talkwall was not used. When only one researcher was present, this researcher concentrated on the video recording, meaning we do not have field notes from these lessons.

The last three columns show the dates and number of recorded meetings and interviews. The more informal meetings with the teacher before and after the lessons were not recorded and are therefore not shown in the table. For the intervention in spring 2017, we used two cameras, one focusing on

the teacher and whole-class activities, and one focusing on focus groups of students. The teacher had a separate microphone. For the recordings in autumn 2018, we used one camera alternating between whole-class interactions and focus groups of students. We used two microphones, one permanently on the teacher and one alternating between the whole class and the focus group in question.

Dates	Recorded lesson	Log from Talkwall	Field notes	Interview—teacher	Interview—student focus group	Recorded meeting
16-09-21			X			
16-09-23	90 min	X				
17-02-09	45 min	X	X			1
17-03-31	90 min	X	X			1
17-04-06	45 min	X	X			
17-05-12	90 min	X	X			
17-05-18	55 min	X	X			
17-06-09				1	2	
18-09-11	45 min					
18-09-14	90 min	X	X			
18-09-18	45 min					
18-09-21	90 min		X			
18-10-09	45 min					
18-10-16	45 min	X				
18-10-19	90 min	X	X			
18-10-26	90 min		X			
18-12-14				1	2	

Fig. 2: Overview of the empirical material

Video recordings have been my main data source. These data have been analysed to study the interactions, but also to give information on how the classroom culture was built and maintained. I used the logs from Talkwall to study the students' contributions on this platform, while the recorded meetings, field notes, and interview data added information on how this culture was perceived, and gave information on the students' view on the use of Talkwall, ground rules for talk, and the teacher's strategies. Together with the recorded meetings, these data also served as a background for rich descriptions. Being present in most of the lessons recorded, as well as informal meetings and talks with teachers and students before and after the lessons, also enhanced my understanding of the classroom culture.

4.4 Studying trajectories

Studying trajectories can make the connection between temporality and learning more transparent, and—importantly—it can provide empirical accounts of how moment-to-moment interaction is part of larger learning activities (Rasmussen, 2012). Aligned with the described theoretical perspective, I wanted to investigate interactional patterns and how students made subject-oriented meanings through interactions. To understand why and how the interlocutors' strategies worked, I wanted to focus on interactional details. At the same time, I wanted to study the processes in which the students' making of meanings evolved over time (Mercer, 2000; Mercer, 2008). Believing that the realised interactions are a consequence of the interdependent relationship between the episodes and an established classroom culture (Linell, 1998), I wanted to employ a method design that allowed me to study both the interactions in detail and the culture in which they were a part. For this reason, I chose to analyse trajectories.

In writing the articles, I chose to delimit the analysed trajectories in different ways. The three planned recorded lessons from the original intervention comprised different topics. In two of them, the teacher did not finish discussing the topic in question. She therefore continued the discussions in the next lesson. We also chose to record these lessons; thus, we recorded a total of five lessons during spring 2017. I have chosen to categorise these recordings into three trajectories defined by subject topic. The eight lessons recorded in autumn 2018 follow one topic—thus, categorised by subject topic, all lessons viewed together constitute one trajectory. During the analyses of Article I, I chose to analyse one of the lessons recorded in spring 2017, constituting a trajectory as described. In the second article, I chose to analyse 14 minutes of coherent interactions following a given assignment, its uptake among students, the teacher's uptake of the students' answers and the classroom discussion that followed. I define these interactions as trajectories within the larger trajectory of eight lessons. In Article III, I combined these different delimination approaches. I analysed the eight lessons constituting the trajectory according to topic and 10 minutes of coherent interactions, following one discussion as a trajectory within the larger trajectory.

4.5 Thematic analyses – data selection and rich descriptions

Choosing to do a case study of one of the teachers was the first reduction in the gathered empirical material. Still, I had to organise the data corpus (Goodwin, 1994). To get an overview of the material

recorded with this teacher, identifying themes of interest for further investigation, as well as choosing episodes for closer analysis, I conducted several iterations of thematic analysis (TA; Braun & Clarke, 2006; 2013; Braun et al., 2019) on the empirical material.

TA is a method for identifying and analysing patterns of meaning in qualitative data (Braun et al., 2019). TA can be applied across a range of theoretical frameworks, and versions of thematic coding have been applied by more quantitatively oriented frameworks that foreground the importance of coding reliability (Guest et al., 2012). However, I followed the version of TA proposed by Braun & Clarke (2006; 2013; 2019) developed for qualitative approaches. This has important implications for how the coding is conducted.

In quantitative research, a code refers to a strictly defined phenomenon recognisable for other researchers to such an extent that several researchers would end up with the same result when applying the same code on an empirical material. The codes applied following Braun and Clarke's version of TA do not have these qualities, and perhaps the term 'code' is misleading. Here, the codes are manly generated inductively, and are not strictly defined. The goal is not to make a quantifiable representation of the material or accurately summarise the data, but to 'provide a coherent and compelling *interpretation* of the data, grounded in the data' (Braun et al., 2019). The codes reflect the researchers' interpretations of what is happening in the data and what the interactions represent. By building themes from these codes, the researcher identifies meaning-based patterns in the material. Braun et al. (2019) argued that the strength of such an approach lies in its depth of engagement with the empirical material. They emphasised the researchers' reflexivity as central to the process of analysis, specifying their approach as reflexive TA. Through the TA I conducted in this thesis, I gained insight into the interactional structures as they evolved over time, as well as the recurrences of specific phenomena enabling comparison. In this way, the TA constituted both an analytical approach and a foundation for further analytical work studying trajectories through interaction analysis.

I first conducted TA on the material from the original intervention (recorded spring 2017). All this material was transcribed. Adapting the process described by Braun & Clarke (2006), I began by familiarising myself with the empirical material by watching the video recordings and listening to the interviews and meetings. I then re-viewed the material while generating codes based on transcriptions. Although video recordings represent a reduction of the material from the original event, they constitute a rich representation of the event (Jordan & Henderson, 1995). Being able to re-watch

selected episodes multiple times helped me better understand the meaning-making. Based on this, I generated codes. Some examples are 'Includes everybody', 'Shows engagement', 'Allows for using time', 'Sees individual students', 'Follows up on student's initiative', 'IRE (initiative-response-evaluation) structure', and 'Use of Talkwall'. Based on these codes, I developed some thematic patterns that I found interesting to investigate further: how Talkwall mediated the interactions, how the teacher performed uptake of students' contributions by building on them in her subsequent teaching, how she acknowledged her students' contributions, and her varied ways of asking questions. Based on these themes, I chose to focus on how the teacher, through her interactional work and use of Talkwall, systematically acknowledged her students' contributions. This led to the work on agentic participation described in Article I. The selection of the data is described in the article and is based on the TA.

After gathering the material from autumn 2018, I used the same procedures to conduct TA on this material. After the familiarisation process, I conducted the coding directly on the video recordings, writing down descriptions and summaries of what happened, and then applying codes on these writings. Examples of codes from this iteration were: 'Student answer', 'Use of ground rules', 'Talk with a peer', 'Monologic talk', 'Dialogic approach', and 'Dialectic reasoning'. Based on this iteration, I identified several themes that I wanted to investigate further. One of these was how the teacher combined what I at that point perceived as dialogic and monologic approaches to teaching to help her students make subject-oriented meanings. This became the topic of my second article. My understanding of what happened evolved during further analyses, so the theme is hardly recognisable in the article. Another topic of interest was the way the students sometimes pursued challenging a topic. This led me to query and became the topic of my third article.

Before I started working on the third article, I conducted a new iteration of thematic analyses. This iteration was more focused than the previous, since I had already identified the theme I wanted to concentrate on. Before I started, I chose some lessons of particular interest and got them transcribed. I then did TA on the material directly from the video recordings and aided by transcripts where I had them. I focused the coding on querying and related topics, such as elaboration, invitation to elaboration, how the class practised ground rules, and the teacher's different strategies for building and maintaining a classroom culture. I wanted to identify all episodes where querying occurred to be able to discuss when it proved productive or not for classroom meaning-making and what organising strategies could promote productive querying. This work is described in more detail in Article III. In

addition, I also allowed inductive codes during this iteration, e.g., 'Example of student understanding', 'Student question showing new understanding', and 'Teacher guiding evolving understanding'.

During the analysis of the data, I discussed problematic occurrences with the co-authors—my supervisors. There were several episodes in which we ended up categorising as querying, which, at first impression, seemed like invitations for elaborations. Sometimes it was hard to decide if a question was merely a question or constituted a challenge to an utterance. In these instances, we let the uptake of the question determine whether we categorised it as querying. We found this reasonable given that one move in itself does not create meaning for the students. It is how the separate moves evolve into interactional patterns that become the process of meaning-making (Bakhtin, 1986; Linell, 1998). These obstacles illustrate why strictly defined coding as typical of quantitative approaches can be misguiding in qualitative research. In the end, defining occurrences of querying depended on our reflexive interpretations as researchers and our deep engagement with the material, including analysing the occurrences in their context. However, using querying as a thematic code in the sense described by Brown and Clarke (2006, 2019) contributed to focusing the analysis. Because the coding identified all occurrences of querying in the material, it gave insights into the varied interactional contexts of the phenomenon. In this way, the coding provided new insights into how the teacher interacted with the students to achieve a better understanding of the topic.

In addition to investigating what the relatively large amount of material could tell me across the lessons and episodes, my aim by doing TA was focusing the analysis. Identifying themes through TA provided me with tools to draw a detailed map of the material. In this way, when I wanted to investigate certain themes more closely or was curious if a phenomenon occurred elsewhere in the material, I could consult this map and easily go back to re-watch certain episodes. Through TA, I gained thorough insights into the empirical material. This insight was crucial for understanding the context and the classroom culture. I also used it to identify episodes relevant to the themes I wanted to investigate further by doing interaction analyses (Furberg & Ludvigsen, 2008; Jordan & Henderson, 1995).

4.6 Interaction analyses

Aligned with the described dialogic theoretical perspective (Bakhtin, 1986; Linell, 1998), I wanted to analyse the interlocutors' subject-oriented meaning-making strategies on a micro-level. To achieve

this, I employed video-based interaction analysis (Derry et al., 2010; Jordan & Henderson, 1995). Rooted in discourse analysis, conversation analysis, and ethnomethodology, Jordan and Henderson (1995) defined interaction analysis (IA) as investigating 'human activities such as talk, nonverbal interaction, and the use of artefacts and technologies, identifying routine practices and problems and the resources for their solution' (p. 39). Focusing on the details of the interactions between interlocutors allowed me to study interactions situated in the authentic context of their occurrence. Because IA takes into account both verbal talk and participants' engagement with objects and artefacts, this approach allowed me to study how the use of Talkwall influenced classroom interactions, as well as provide insights into the organisation of educational settings.

Linell (1998) described how all interactions are contextually embedded, utterances simultaneously relating to the interlocutor and the social context in which the interaction is a part. Aiming at contextualising students' microlevel interactions, IA combines microlevel analyses with ethnographic data. Jordan and Henderson (1995) described their approach of IA as embedded in ethnographic fieldwork consisting of varied empirical material, including, for example, observations, artefacts and documents. By conducting rich descriptions based on ethnographic material, students' microlevel interactions may be contextualised both on the level of classroom culture and the school as an institution. Jordan and Henderson recommended organising the video recordings by content logs as a basis for a quick overview and locating sequences or issues of interest for further investigations. The content logs have many similarities to the TA conducted in this thesis. I chose to use TA because I found that this approach offered tools that allowed for a richer initial analysis. In addition to being a way of organising the material, I used the TA to analyse the larger context. Furthermore, I chose to analyse trajectories to be able to study the local contexts of the microlevel interactions, as well as the students' evolving understanding. Through these approaches, I was able to study microlevel activities as part of locally situated contexts, classroom culture, and institutional practices (Linell, 1998; 2009; Mercer, 2004).

Based on the TA, I chose specific episodes for IA. This meant that I had some preliminary understanding and notions of what I was going to find during the IA. Aiming to account for how the participants actually engaged in meaning-making processes without being influenced by these preliminary understandings, I employed a two-step analytic approach, consisting of first- and second-order analysis (Linell, 1998). The first-order analysis involved mapping what the participants did during their interactions, with the aim of not making interpretations from an analytic perspective and

without letting the descriptions be biased by previous assumptions. I did this analysis by giving a detailed description of the students' actions and utterances. Making the participants' interactions the analytical starting point, it was possible to investigate how they made subject-oriented meanings by building interpretations and argumentations from these interactions (Enqvist-Jensen et al., 2017; Furberg & Ludvigsen, 2008; Omland & Rødnes, 2020).

The analysis was done turn-by-turn, focusing on the interlocutors' responses to each other's utterances. I based my interpretations on how the interlocutors' uptake of the previous speaker's utterance showed their interpretation of it (Linell, 1998). With this method, the focus of the analyses was not on single utterances but on their position in a chain of utterances (Bakhtin, 1986). By investigating this chain, I was able to study how the interlocutors made meaning through interactions.

In the second-order analysis, I systematically interpreted the participants' utterances and actions from the point of view of the aims of the studies. By grounding the analyses in the description I made during the first-order analyses, I aimed to reduce the possibility of biased interpretations. In all three studies, the IA added considerably to my preliminary interpretations. As such, the IA not only served to confirm preliminary assumptions but also added immensely to my understandings and sometimes changed my initial conjectures.

Analysing video data is an iterative process (Derry et al., 2010). Analysing the excerpts, I constantly moved back and forth between interpretations, recordings, transcripts, aims, and research questions. I experienced that by viewing the same often very short sequence repeatedly, I nearly always noticed new aspects. This made it clear how crucial these analytical iterations was. It also showed me the importance of discussing the episodes with other researchers (Jordan & Henderson, 1995). One of the benefits of being part of the DiDiAC project was that it allowed me to discuss excerpts regularly with other researchers. I also discussed excerpts with researchers from the research group I participate in at UiO, Living and Learning in the Digital Age (LiDA), at PhD courses with fellow PhD students, as a participant in the DigiChild network, and at the Earli SIG 10–21–25 in summer 2020. These discussions were invaluable, and the collaborative viewing of selected episodes was vital in validating interpretations (Derry et al., 2010; Joran & Henderson, 1995). These interactions widened my understanding of the phenomena in question immensely.

Chapter 5: Research credibility and ethics

When conducting qualitative research that is interpretive in nature, like the research conducted in this thesis, it is important that the analyses and findings are credible and compelling. Credibility refers to the criteria by which one can judge the quality of a logical set of statements identified in the methodology employed (Yin, 2014). In general, I applied two main strategies to ensure that the research was trustworthy and attained rigour: I made analytical inferences, and the methodological approach employed was verifiable and transparent. I also moved between the microlevel of the empirical material and the macrolevel of the employed theoretical perspective when making theoretical assumptions (Morse et al., 2002). In this paragraph, I give a more detailed account of the strategies employed to ensure methodological quality from the point of view of reliability and validity before I reflect upon the potential for generalisation and the ethics related to this research.

5.1 Reliability

In quantitative research, reliability refers to the potential replication of the findings (Murnane & Willett, 2010). In qualitative research, it is questionable whether it is possible to achieve reliability in this way (Lewis et al., 2014); accordingly, the term has been conceptualised differently. Seale (1999) emphasised that reliability in qualitative studies could be achieved by 'showing the audience of research studies as much as is possible of the procedures that have led to a particular set of conclusions' (p. 158), while Silverman (2020) emphasised that the findings of a study should be independent of accidental circumstances of their production. Reliability is thus linked to the quality of the data. To achieve reliability, transparency of research procedures is crucial (Moisander & Valtonen, 2006). In the three studies in this thesis, the reliability of the research was built on rich descriptions and transcripts of video recordings.

Even though video data do not capture every detail in the recorded interactions, they provide high-quality data because they represent the original events to a high extent. Transcripts of video data have a strong position concerning reliability because the transcripts and recordings are available for inspection by other researchers (Peräkylä, 2004; Silverman, 2020). To provide the reader with a clear understanding of the depicted data, I have based the transcripts on a slightly modified version of Poland's (2001) system, which is listed in the appendices of Article II and III. These notations provide the reader with a richer description of the interactions and make it possible to consider the

trustworthiness of the data (Furberg, 2009). I chose a level of description in the transcripts that I found sufficient for the purposes of the studies. I included pauses and overlapping speech because these phenomena had implications for the research questions. I excluded phenomena of lesser implications for the research questions (e.g., intonation) because I felt they would interrupt the readings of the transcripts more than they would clarify interpretations.

The video recordings were originally in Norwegian, and all interactions were translated in the articles. This is problematic, as the translations constitute an interpretation and deprive the reader of more direct access to the utterances (Rødnes et al., 2021). However, I have tried to make the translations as directly as possible to avoid divergences. I kept the original language alongside the translation until the final drafts of the articles, and thus got help in controlling the quality of the translations from critical readers in several forums. In addition, many of the utterances were incomplete or consisted of sound expressions and not actually words. I have chosen not to edit the translations but keep them incomplete, aiming at depicting the original ambiguities, because such utterances are typical of interactions where interlocutors are thinking while speaking. Thus, these unclear half-finished sentences and sound expressions are highly significant for interactional meaning-making. The teacher's use of 'mhm' (Article I) and the students' use of 'what?'[1] (Article II) are two examples of this.

To explain the context of the analysed transcripts, I applied rich descriptions. These are based on the TA, and as the data they are analysed from are not included in the articles, they do not have the same level of transparency as the IA. To enhance reliability, I therefore chose to include short examples of transcripts of episodes on which I based the inferences of the TA when the scope and focus of the article allowed it (see Section 5.3, Article I, Section 3, Article II, and Section 3.2–3.4, Article III).

[1] In Norwegian the students say «Hæ?» which is a sound expression and not an actual word, but which is frequently used as meaning the English "What?"

5.2 Validity

The term internal validity describes the extent to which we can say that relevant evidence supports the inference drawn in a research project (Shadish et al., 2002). In qualitative research, validity refers to whether the analytic claims about the data, as well as the strategies used to make these claims, can be regarded as convincing (Brinkmann & Kvale, 2015; Silverman, 2020).

In the studies done in this thesis, I have tried to secure validity using varied methods. IA is a transparent approach. Using this method, I describe the analytical reasoning moment by moment, allowing readers to follow the analytical steps. In this way, readers are able to evaluate whether or not the inferences are trustworthy, as well as the analytical argumentation. They can reach other conclusions, or question the evidence on which the findings are based (Peräkylä, 2004). Furthermore, I have not been alone in the analytical work. Jordan & Henderson (1995) emphasise the importance of discussing interpretations of data with co-researchers. As mentioned (Section 4.4), I have discussed the analysed episodes in various forums, and I have discussed all the conducted IA thoroughly with my supervisors, who have also co-authored two of the articles. Kari Anne Rødnes has had deep insight into the teachers' work, being the senior researcher responsible for gathering the empirical material with this teacher. The inferences from the TA were thoroughly discussed with her, in addition to the discussions in other forums.

IA ensures transparency about analytical argumentation, but it can represent another challenge to validity, namely, the reasoning behind choosing the analysed extracts. I have tried to meet this challenge by conducting TA on the whole dataset. Through this approach, I have been able to describe to what degree selected episodes are representative of the teacher's strategies and, when relevant, to describe all occurrences of a phenomenon, as in Article III.

A similar problem with validity in qualitative research is the extent to which the data are representative. I have addressed this issue by choosing to record a longer trajectory with the teacher, in addition to the original intervention. In this way, I gained broader insights into her strategies and how they influenced her students' meaning-making. In combination with conducting iterations of TA, this approach ensured that the extracts chosen illustrated typical teaching strategies applied by this teacher. To make the reasoning that laid behind the selection as transparent as the scope of the studies allowed, I described the process in the method section of each article, and applied rich descriptions based on the TA. By these descriptions, I hoped to illustrate the classroom culture that, through an

interdependent relationship, both allowed the teacher's strategies and was a result of them. In this way, I wanted to invite the reader into the research setting and supply a broader foundation for making decisions with regard to the study's credibility (Brinkmann & Kvale, 2015; Silverman, 2020). By combining TA and IA, I tried to unveil different facets of classroom interactions and what actually occurred in this natural setting (Silverman, 2020).

A final issue regarding the studies' validity concerns external validity, the degree to which a study's findings are generalisable beyond the immediate study (Yin, 2014). This issue is associated with generalisation, which I will discuss in the following section.

5.3 Generalisation

In quantitative-oriented studies, generalisation refers to the possibility of transferring the findings from a study to a larger population (Lewis et al., 2014; Silverman, 2000). Such *statistical generalisations* are not applicable to qualitative studies. In IA studies like the ones in this thesis, generalisation can be addressed by focusing on the extent to which the findings from one educational setting are applicable to other educational settings (Ercikan & Roth, 2006). Such inferences can be seen as *analytical generalisations*. Brinkmann and Kvale (2015) described such generalisations as involving 'a reasoned judgement about the extent to which the findings of one study can be used as a guide to what might occur in another situation' (p. 297). Such generalisations depend on rich contextual descriptions, and the logic of inquiry is made explicit (Derry et al., 2010) so that a reader can judge the soundness of both the transferability to other situations and the generalisations. Analytical generalisations involve making inferences based on combining a theoretical perspective, findings from previous research, and the empirical material studied.

Conducting the research of this thesis, I employed the lenses of sociocultural and dialogic perspectives, arguing that classroom meaning-making is situated. As such, the only possible way to generalise is analytical (Brinkmann & Kvale, 2015; Lewis et al., 2014). This implies that the generalised findings are based on a combination of the inductive generated findings from the empirical analyses, findings of related studies, and the applied theoretical perspectives. In the studies included in this thesis, I make several such analytical generalisations, especially regarding the teacher's strategies. For other teachers to organise interactions leading to similar subject-oriented meaning-making, it is not sufficient to

repeat the teacher's strategies. The strategies need to be adapted to the particular situation. For others to adapt to them successfully, it is crucial that they understand how and why they work. By giving detailed empirical descriptions on how particular interactional strategies work, as well as by giving theory-based explanations of why they may prove productive for students' learning, I have aimed to give sufficient explanations for others to adapt them.

5.4 Ethical considerations

The DiDiAC project has been authorised by the Norwegian Social Science Data Services (NSD). The research in this thesis followed the ethical guidelines for the social sciences formulated by the NSD. The teacher gave informed consent. Because the students were under the age of 18, we collected informed consent from their guardians. This was done twice, before the original intervention in 2016/2017 and before we started the recordings in autumn 2018. All participating students submitted a consent form signed by their guardian. The consent form gave thorough information about the project, about data collection, storage, and use, and also explained the right to withdraw from the project.

The transcribed data were anonymised, and all participants' names were replaced with pseudonyms. The names and locations of the participating schools were not used in any of the published material. The data have been, and are still, stored securely on devices accessible only to the researchers participating in the DiDiAC project. Video material has only been presented in closed research or project meetings in accordance with the application to NSD and the information provided on the consent form.

The students received thorough information about the project from both teachers and researchers. They were also informed about the opportunity to withdraw from the project. Even though we did our best to be as unintrusive as possible, our presence as video-recording researchers, to some extent, must have influenced the classroom interactions. To counteract the potential disadvantages of being part of the research project, we aimed to involve the participants in the project in such a way as to make the goal of the project compliant with their goals (Guillemin & Gillam, 2004). In the DiDiAC project, the teacher and researchers discussed teaching strategies, but the teachers planned and organised the lessons to match their teaching plans. The teachers were involved in the development

of Talkwall. By designing the organisation of the teaching and the ground rules, the teachers and, to some extent, the students were part of the development of the project.

Chapter 6: Summary of the articles

As described in the method section, the empirical material in the three articles in this thesis is from the DiDiAC project, an intervention study in which the aim was to develop teaching practices that combined dialogic teaching with the microblogging tool Talkwall. The three articles discuss the strategies of the same teacher, but focus on different aspects of her teaching, analysing educational trajectories by combining TA and IA. My supervisor Kari Anne Rødnes co-authored Article I. On Article II, I was the sole author, while I wrote Article III together with both my supervisors, Kari Anne Rødnes and Sten Runar Ludvigsen. I was first author on Article I and III. The articles were written in the order in which they are presented.

6.1 Article I

Omland, M., & Rødnes, K. A. (2020). Building agency through technology-aided dialogic teaching. *Learning, Culture and Social Interaction*, *26*, 100406.

Following the whole-class interactions in one lesson in which the teacher used Talkwall to facilitate the transitions between the group and whole-class interactions, this article investigates how the teacher helped to build her students' participatory agency through interactions. Agency is seen as a condition for participation and engagement. The aim is to understand the meaning and role of the teacher's dialogic moves, acts of positioning, and technology mediation in the promotion of students' agency, and thus to help explain one aspect of how dialogic teaching mediates students' learning processes.

Agency is conceptualised as comprising both the students' sense of agency—the students' perceived capability to act (Hilppö et al., 2016)—and the social structures that influence the students' possibilities to act (Holland et al., 1998). Building on the findings of previous studies that show how dialogic interactions can be productive for students learning (Alexander, 2012; Howe et al., 2019; Mercer et al., 1999), the article investigates how the teacher's dialogic moves influence the positioning of the students' contributions in relation to classroom meaning-making and how these processes influence the students' agency. How dialogic moves, positioning, and agency are intertwined is focus for the explorations. Because previous research has shown how technology can mediate dialogic interaction by facilitating joint attention to shared contributions (Mercer et al., 2010), thus functioning as a basis for further discussion (Rasmussen & Hagen, 2015), the use of technology was central to the study.

When studying these questions, we wanted to follow the students' contributions, so we chose to focus on one lesson analysing a trajectory. Based on the TA conducted on the material recorded with the focus teacher from the intervention in spring 2017, this lesson was chosen because the teacher let the students' contributions guide the evolvement of the discussions. In addition, we chose to include extracts from the interviews in which the students discussed topics related to our research questions as identified by the TA.

The teacher orchestrated the entire lesson by building on her students' contributions. All interactions were initially grounded in elaborating on one groups' contribution, a very powerful way of performing uptake. She used Talkwall in a way that made all the students' contributions visible to the whole class before she used the contributions in question as the basis for further discussions. The teacher also practised a range of dialogic moves that positioned her students' contributions as crucial for classroom meaning-making. She asked open questions, often initiating uptake of group discussions by asking, 'What did you talk about?', an open invitation without a right or wrong answer. She performed uptake by asking for elaborations, by revoicing, or by asking the students about their meaning of others' contributions. In this way, she showed the students that she valued their contributions as valid and important for classroom interactions. Another important dialogic move was her pensive use of 'mhm'. With this utterance, she showed that she was reflecting on the students' contributions, finding them worthy of reflection, and allowing the students thinking time before elaborating.

By means of these strategies, the teacher positioned the students' contributions as crucial for dialogic exploration in the classroom. We argue that by positioning their contributions as important to such an extent, she built their agency for further participation.

6.2 Article II

Omland, Maren (2021). Technology-aided meaning-making across participation structures: Interruption, interthinking and synthesising. *International Journal of Educational Research, 109*, 101842.

This article analyses a 14-minute trajectory following one group's discussion prior to making a Talkwall contribution, their discussions of other groups' Talkwall contributions on the same topic, and finally a whole-class discussion of the group's contribution. The aim is to investigate the differences in interactional strategies used in groups and the whole class, how these particular strategies influence

the students' meaning-making, and how technology can be used to facilitate the combination of these different participation structures.

By analysing dialogic interactions, the article builds on dialogic theories regarding meaning as constructed in the tension between utterances (Bakthin, 1986). Furthermore, interruptions are regarded as an interactional tool interlocutors can use to collectively make meaning by building on each other's utterances (Nikulin, 2010; Yakubinsky, 1997). The concept of interthinking is used to describe how interlocutors, through joint intellectual activity, can use language to think together and solve problems, and thus achieve more by working together than alone (Mercer, 2000). To describe talk where multiple meanings emerge and the process is directed towards evaluating or comparing different views to find temporal consensus or sharing, the concept synthesising is applied (Rommetveit, 1992; Wegerif, 2008).

The article builds on previous research on dialogic interaction (Mercer & Littleton, 2007; Nystrand et al., 1997; Scott et al., 2006) and coordination (Barron, 2000), discussing the interactional strategies used during group and whole-class interaction. Barron (2000) showed how the coordination of thoughts was particularly important for students to collectively make new meanings during group work. Mercer and Littleton (2007) showed how exploratory talk was found to characterise interactions that were particularly productive for students' learning. The discussion between a monologic approach, where knowledge is treated as a fixed and a dialogic approach where knowledge is treated as something that can be explored and examined, became central in the discussion of approaches to whole-class interactions (Nystrand et al., 1997; Scott et al., 2006).

The TA of the trajectory recorded in autumn 2018 led focus to how the teacher balanced classroom meaning-making by combining group and whole-class interactions. On this background I chose to investigate the particularities of the interactions in the different participation structures further by investigating a trajectory where one groups' meaning-making was followed across participation structures.

The findings showed how, during group talk, the students made meanings by interrupting each other and using the informal 'what?' to achieve coordination. The meaning-making depended on the exchanges of voices. When reading the other groups' Talkwall contributions, the students began their synthesising work by comparing their posts to others'. During the whole-class conversation, the

teacher built the conversation from the students' utterances by using the group's Talkwall contribution as a starting point and asking open questions, inviting elaborations, and revoicing the students' contributions. Using these strategies, the teacher guided the interthinking towards a synthesised shared way of thinking about the subject.

The findings suggest that, at least in classrooms, monologue and dialogue are not a dichotomy. As discussed, the interactions in the whole class had both dialogic and monologic qualities. The teacher used both dialogic and monologic strategies, depending on the aim of her action. She built the interactions from her students' voices, all the time keeping her aim of reaching a predefined meaning. In this hybrid dialogue, she used guided interthinking as her most prominent tool.

The use of Talkwall facilitated the transition between the group and whole-class interactions and made the students accountable for the group interactions. Furthermore, Talkwall provided a visual representation of the class's combined efforts and allowed the students to explore and compare ideas from the rest of the class to their own. In this way, the technology served as a visualisation that both opened a dialogic space for sharing ideas and supported the process of novel combinations of them.

In the empirical material for this article, interruptions were a dominant tool for meaning-making in groups. Interruptions were particularly productive in achieving coordination of thoughts and thus the exploration of multiple views. In these ways, interruptions supported the process of interthinking. Serving as a foundation for synthesising during the whole class, the group dialogues became an indispensable part of the process of reaching mutual understanding. During group talk, meanings were explored without evaluations, whereas the guided interthinking during whole-class conversation seemed directed towards valid knowledge. Overall, the dialogues created opportunities for the students to participate in subject-oriented meaning-making, building on their previous experiences and knowledge.

6.3 Article III

Omland, M., Ludvigsen S.R., & Rødnes, K.A. (submitted). The role of querying: Investigating subject-oriented dialogic meaning-making.

Following a 10th grade class and their teacher through eight lessons in social science, this article explores how teachers can facilitate querying that is productive for students' learning and how querying can contribute to students' meaning-making.

Grounded in the view that an evaluative epistemic stance is necessary for students to explore topics through dialogue (Kuhn, 1991; Reznitskaya & Gregory, 2013), the article builds on research investigating how dialogic interaction can contribute to students' meaning-making. Encouraging exploration and challenging of different ideas can help students acquire deeper and more complex disciplinary expertise (Krange & Ludvigsen, 2008; Reznitskaya & Gregory, 2013). As querying operationalised as doubting, full/partial disagreement, challenging, or rejections of a statement, have been found to be a dialogic move particularly associated with students' learning (Howe et al., 2019), we chose to focus our investigation on this concept. Because digital tools used in specific ways have been shown to be productive in mediating dialogic interactions, we investigate how the use of Talkwall can contribute to facilitating classroom querying.

Analysing the eight-lesson trajectory using TA, all episodes where querying occurred were identified and categorised according to productivity defined by uptake. We then conducted IA on the identified episodes, discerning what the querying looked like in each, its uptake, and how it was facilitated through the previous interactions. Wanting to investigate the facilitation and uptake of productive querying (operationalised by uptake) in detail, we chose to focus on the presentation of the analyses of one of the episodes where the querying proved most productive.

Our findings identify three main teaching strategies for facilitating productive querying. The assignment asked the students to take a stance, thus making judgements. These judgements constituted contrasting ideas that were visualised by the use of Talkwall. These visualisations served as a starting point for the students' evaluation process. The teacher positioned the students with the role of querying through the assignment. This role implied a breach of classroom norms; thus, assigning it enhanced the probability for it to occur. In the episodes where querying proved most productive, the teacher did uptake of the students' querying and asked the students to discuss the query further. This

way of performing uptake seemed crucial for the level of productivity. After this uptake, the teacher's role became withdrawn, allowing the students space to explore the topic freely.

The findings show that querying can contribute to expanding the dialogic space because it often represents a new voice that introduces new topics and leads to new explanations. Querying can also deepen the dialogic space by introducing contrasting voices, which provide a foundation for comparison and evaluation. Furthermore, querying can lead to continued reflections. In the analysed trajectory, the students raised a line of argumentation from the analysed discussion in the next lesson. This indicates that, by not reaching a conclusion or agreement, they continued to reflect on the topic. We hypothesise that this kind of continued reflection can lead to increased learning outcomes.

The analyses showed how querying often requires cognitively challenging coordination, and that it can also help coordination because it sometimes reveals misinterpretations or confusion and serves as an invitation to repair. In these ways, when students are queried, they have to coordinate their thoughts with another person's ideas, expanding their thinking beyond their previous reasoning. By partaking in interactional trajectories in which querying occurs, students can experience reasoning and evaluations, leading to better understanding and explicit argumentation. In the analysed trajectory, the teacher positioned her students as authors of arguments that were used to make new meanings. In this way, she built their agency as evaluative epistemic thinkers (Kuhn, 1991).

In this article, we show how students were allowed space to explore their ideas and how they explored this opportunity by expanding this space. Querying led to demanding coordination and continued reasoning. This helped the students' understand each other's positions while seemingly agreeing to disagree. We argue that processes like these support the building of an evaluative epistemic stance, of argumentative competence, and ultimately of citizenship by being able to understand that other people see the world differently, respecting their views even when disagreeing, on a justified basis.

Chapter 7 Findings and contributions

7.1 Teaching strategies – empirical contributions

The empirical findings in this thesis comprise teaching strategies that can promote classroom dialogue by building new understandings from students' contributions. Through detailed analyses of interactional phenomena, this thesis contributes to the understanding of how and why dialogic teaching may prove productive for students' learning.

7.1.1 Talkwall

Previous research has shown how microblogging tools and interactive whiteboards can facilitate classroom interactions by, for example, increasing student participation and engagement (Ebner et al., 2010; Gillen et al., 2007), visualising student contributions, facilitating teacher uptake (Mercier et al., 2015; Rasmussen & Hagen, 2015), and prompting exposure to alternative perspectives (Kerawalla et al., 2013; Major et al., 2018). The analyses conducted in this thesis add to these findings by showing how Talkwall displayed the class's varied voices from group interactions. By letting the students explore topics in groups before they made Talkwall contributions, the teacher ensured broad student participation and made the students' thinking processes from the groups transparent in whole-class interactions.

Talkwall constituted a visualisation of the class's combined effort. This visualisation served as a placeholder for the students' ideas and as a basis for further discussion. Because the teacher consistently used the students' Talkwall contributions as learning resources in the following interactions, the way Talkwall visualised the students' contributions served as a powerful uptake, showing them the importance of putting effort into the posts. In this way, Talkwall mediated the positioning of the students' contributions as building blocks for the joint construction of subject-oriented meanings. Talkwall also constituted a visualisation of contrasting ideas. This sometimes led to deepening of the dialogic space by initiating synthesising (Article II) or querying (Article III). Through these analyses, this thesis contributes to the research on how digital tools can mediate classroom interactions by pointing out strategies that are productive for subject-oriented meaning-making in varied ways. Central for these strategies are the way they allow the tool to constitute a powerful bridge between the participation structures. This bridge integrates the meaning-making in the different structures, making it more powerful than each structure would allow alone.

7.1.2 Mobilising prior knowledge by combining peer and whole-class interactions

The teacher consistently let the students explore topics with peers, using contributions from these interactions to guide them towards valid knowledge in whole-class interactions. She used this strategy with and without Talkwall. In this way, she mobilised their prior knowledge (Barton et al., 2008; Moje et al., 2004) and guided them towards new understandings based on this. She initiated the explorations in groups or pairs by asking open questions or giving open assignments (Michaels et al., 2010; Nystrand et al., 1997). Often she performed uptake of these explorations by asking open questions such as 'What did you talk about?' or valuing their contributions without evaluating them against a predefined answer. In Article III, we also saw how she positioned students with the authority to query other students, thus enhancing subject-oriented exploration among peers.

As in the knowledge-building approach (e.g., Chan, 2012; Hakkarainen, 2003), students' inquiries in groups were an important aspect of this teacher's strategies. Her way of building meanings on students' contributions and valuing *all* students' contributions highly mirrors strategies emphasised by the accountable talk approach (Clarke et al., 2016; Gresalfi et al., 2009). However, the analysed interactions add to these approaches by showing how these strategies can be supported by using Talkwall to combine participation structures. The teacher's approach mediates broad participation, and because Talkwall allows all student contributions to become visible to all participants, it also facilitates valuation. The students' statements in the interviews confirmed this (see Article I).

7.1.3 Dialogic moves

The teacher practised a range of moves, promoting dialogic interactions and student participation. As mentioned, she used open-ended questions as a prominent tool for promoting student participation. Her way of performing uptake, by building on the students' contributions in further meaning-making, showed them that she valued their contributions. She also revoiced their utterances, showing that she understood their intentions when their phrasing was sometimes unclear. Her use of 'mhm' served various purposes; sometimes it validated the student's utterances, sometimes it gave the students time to reflect, and sometimes it served as an invitation to elaboration. The teacher's moves had many similarities with the moves identified by Nystrand et al. (1997) and with the talk moves advocated for by the accountable talk approach. This thesis adds to the understanding of such moves by analysing how they can contribute to influencing students' agency and, thus, how students engage in subject-oriented meaning-making.

Some moves stood out as typical in the interactions amongst peers. The way they interrupted each other and used the informal 'what' was particularly productive in achieving coordination and served as interactional tools for interthinking. Querying also served these purposes and represented contrasting voices (see Article III), often widening and deepening the dialogic space. However, productive querying depended on the teacher's organisation. As discussed, exploratory talk is central in the Thinking together approach (Section 3.1.2). By showing how querying can be facilitated, this thesis identifies tools teachers can use to enhance dialogic exploration in classroom conversations.

7.1.4 Synthesising and guided interthinking

The teacher systematically built on students' contributions from peer interaction to guide them towards valid knowledge in whole-class interactions. She often did this by synthesising different student voices. To describe this process, I have used the term 'guided interthinking' (see Article II). Even though the teacher guided the students, I argue that they were interthinking (Littleton & Mercer, 2013; Mercer, 2000) because the students' contributions were decisive for the development of the interaction and the meaning-making. As such, the making of subject-oriented meanings was a joint construction (Linell, 1998). Through this guided interthinking, the teacher positioned her students' contributions as crucial for subject-oriented meaning-making, thus valuing them to a high extent. These approaches share aims with the community of learners (Engle & Conant, 2002) and knowledge building (Chan, 2012; Hakkarainen, 2003), as building meanings from students' contributions becomes central. However, the teacher's approaches focus on preserving curricular demands, where knowledge building and the community of learners advocate building the classroom agenda from students' initiatives.

7.1.5 Building and maintaining a classroom culture for subject-oriented meaning-making

During the intervention in spring 2017, the class developed a set of ground rules (Edwards & Mercer, 1987). In the first lesson of the recorded trajectory from autumn 2018, the teacher reminded the class of these rules; they discussed them and made some small adjustments. Through practising the above-described strategies and practising ground rules for talk, the teacher developed a classroom culture in which subject-oriented meanings were jointly constructed through interactions. These aspects show how the teacher's strategies also support the aims of both the community of learners and knowledge-building approaches, where building cultures for inquiry was central.

Even though the evolvement of classroom culture is not the central topic of either of the articles, I argue that this is crucial to understand why the analysed teaching strategies were successful. In order to engage her students in the analysed dialogic activities, the teacher rested upon a classroom culture for dialogic interactions practised over time. I hypothesised that the analysed episodes and the classroom culture were interdependent. Through the interchange of knowledge and interactional means between the level of situations and culturally established meaning potentials, the classroom culture gradually evolved. The kinds of student participation seen in the analysed episodes depended on this culture, and the culture was built and maintained through these episodes.

7.1.6 Implications of the empirical findings

The described empirical findings draw on previous research studying classroom interactions found to be productive for students' learning and the use of mediating technologies. My findings add to this research by exploring new contexts and tools. In all three studies, I argue for teaching strategies that promote subject-oriented meaning-making. I analyse why and how the strategies proved productive for students' learning in the analysed empirical material. During the analyses, I strived to show the importance of small interactional details and how they influenced the interactions, as well as how the culture that allowed these interactions was built and maintained. Based on previous research, the employed theoretical perspectives, and detailed analyses of the empirical material, I hope to show how other teachers and educators can employ similar strategies productively. My aim is not that others should copy the analysed teacher's strategies in detail, but by understanding how and why these strategies work, be enabled to adapt productive aspects into their own teaching approaches.

The teaching approaches discussed in Section 3.1 constitute teaching projects that demand a comprehensive change in curricula and ways of teaching. The findings put forward in this thesis build on this research, but try to identify less intrusive strategies. The aim has been to identify strategies that can help teachers improve dialogic meaning-making in their classroom, building on their existing approaches in such a way that they do not have to change everything they do. One of the central issues has been balancing between meeting the existing curricular demands and building on students' meaning-making in ways that maintain an evaluative epistemic stance. Article II mirrors this dilemma to the largest extent.

7.2 Theoretical contributions

This thesis comprises two kinds of theoretical contributions: recontextualising of theoretical concepts, and explanations on how details in particular interactional moves can contribute to joint construction of meaning.

Previous theory and research have conceptualised the phenomena that I study in different ways. As I have situated my research in sociocultural and dialogic fields, I build on the conceptualisations brought forward by others in these fields. The core concepts that I build on are discussed in Chapter 2 and summarised in Section 2.7. The articles add richness to the understanding of these conceptualisations by recontextualising them and explaining new connections between them. In Article I, we discuss how positioning students' contributions as fundamental learning resources for joint subject-oriented meaning-making contributes to building students' agency for participation in further meaning-making. By thus empirically showing the connections between positioning, participatory agency, and meaning-making, we reveal new connections between the concepts. In Article II, I describe how combining dialogic explorations with guidance towards shared knowledge can enhance subject-oriented meaning-making. Here, the focus is on the interactional differences between talk with and without the teacher present.

By describing how the differences in the interactional patterns enhance meaning-making in important but different ways, I show that combining these participation structures can enhance subject-oriented meaning-making. Through these arguments, I discuss how intentionally combining dialogic explorations with guidance that includes both dialogic and monologic aspects can enhance learning. In Article III, we discuss how querying can contribute to deepening and widening the dialogic space, as well as promoting an evaluative epistemic stance and cognitively demanding coordination. We added to the understanding of the connections between querying and epistemic stances with detailed investigations of the role of querying in a trajectory of eight lessons. We also describe the connections between querying, coordination, and dialogic space.

The second kind of theoretical contribution in this thesis consists of explaining how details in the interactional moves contribute to the joint construction of meaning. By describing these details, the thesis adds to the understanding of dialogues. Where Linell (1998) showed how dialogic meaning-making constitutes a joint construction, and described the complexity of such interactions, much educational research has focused on how specific moves can lead students to elaborate, think, and

reflect further (e.g., Mercer & Littleton, 2007; Michaels & O'Connor, 2015), and how teachers can acknowledge students' contributions through uptake (e.g., Nystrand et al., 1997). This thesis adds to this research by explaining new connections between specific moves and conditions that can enhance subject-oriented meaning-making. In Article I, we discussed how the teacher, through the use of specific dialogic moves, enhanced the students' agency for participation. In Article II, I showed how exploiting the particularities of different moves from students' interactions in groups and teacher and students' interactional moves in whole-class interactions allowed for reaching valid knowledge through guided interactions, building on students' contributions. In Article III, we discuss how facilitating querying can enhance students' reflective epistemic thinking. By showing how particular moves serve as tools for meaning-making in particular situations, this thesis contributes to explanations of what constitutes subject-oriented meaning-making in classrooms.

These two kinds of theoretical contributions are of course connected. They originate from theory and empirical data. The difficulty of making clear categories reflects how theory and empirical data have been intertwined in the work of this thesis. Moving between studying concepts and previous research and analysing data has been a process of many iterations. These iterations have been a great advantage because they made me open to how the data can be interpreted. At the same time, they helped me understand the data better by employing relevant theoretical perspectives. These interchanges between using concepts and theoretical perspectives and studying data made it possible to develop new insights into classroom settings.

7.3. Methodological contributions

The methodological approaches employed, in which I combined TA and IA, allowed me to study the interdependence between culture, situations, and episodes. In all three articles, I studied learning trajectories, focusing on specific illustrating episodes. This allowed me to study the evolvement of the interactions, as in Article II, in which I follow a specific assignment through several participation structures. Furthermore, combining TA and IA allowed me to study the interdependence of classroom culture and specific episodes. This combination of TA and IA is relatively new, and previous studies employing it have often limited the approach to using TA to justify selections of episodes for IA (e.g., Silseth, 2018). Combining TA and IA to study the interdependence between culture and episodes was perhaps most prominent in Article III. The investigation of how querying could be facilitated

depended on this combined approach. Among other things, it revealed how querying was related to the use of Talkwall. I argue that the way I have combined TA and IA to investigate the interdependence between culture and episodes constitutes a methodological contribution.

I argue that the recontextualisation of central concepts constitutes a theoretical contribution, and that employing these concepts as analytical tools constitutes a methodological contribution. In Article II, this comprises interruption, synthesising, and guided interthinking, and in Article III, the concepts of querying and coordination.

7.4 Final remarks and reflections

I introduced this extended abstract by hypothesising that 'giving students the opportunity to engage in subject-oriented interactions at school will influence a) their understandings of how democracy works, b) their capacities to become participating citizens, and c) their learning processes'. I hope that this thesis has substantiated this hypothesis by showing that students can enhance their understanding of how democracy works by engaging in classroom activities such as the ones analysed in this thesis, where different perspectives are discussed and evaluated. This implies developing an evaluative epistemological stance, which is demanding, since these need to build on assumptions where more than one position and line of argumentation can be valid. Furthermore, engaging students in classroom interactions by showing them that their contributions are important for subject-oriented meaning-making can influence their sense of participatory agency, and thus lead to further engagement. I argue that it is reasonable to suppose that this applies to situations outside the classroom and in society in general. Finally, I have shown how students' perspectives can be widened through classroom interactions in which different views are discussed and contrasted. Such interactions demand coordination of thoughts and can lead to continued reasoning, evaluations, and synthesising of different voices. These processes can be supported by the teacher's guidance, and I argue that they influence subject-oriented meaning-making and thus also the students' learning processes to a high extent.

In the three articles, I discuss how the teacher organised and guided interactional meaning-making. Throughout this extended abstract, I have, for the first time, emphasised how this meaning-making constitutes a joint construction. This reflects an insight that has emerged gradually. In hindsight, I

think my focus while working on the articles might have been a little split: I focused on the students' interactions, and I focused on how the teacher organised the work and the interactions with the students. Working with this extended abstract allowed me to gain a broader perspective on the analyses of the case as a whole. This gradually led me to see how the meaning-making that took place constituted a joint construction where the teacher and the students interacted, which implies a slight alteration of the focus, emphasising the importance of the students' contributions for subject-oriented meaning-making. Even when the teacher guided the interactions, they were making the meanings together. This insight made me more aware of the connections between this kind of classroom interaction and citizenship and democratic values. The teacher's strategies helped the students learn how they could influence their surroundings through reasoning and argumentation, and they experienced that their voices were important contributions. To experience that engagement matters can lead to further engagement (Clarke et al., 2016), and I believe that taking part in interactions such as the ones analysed in this thesis can help students become active participants in democratic societies.

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PART II: THE ARTICLES

Article I

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Building agency through technology-aided dialogic teaching

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ABSTRACT

Rooted in the sociocultural tradition, this article examines how one teacher helps her eighth-grade students build agency through dialogic teaching supported by technology. Students' agency is essential for their participation in dialogues and thereby their learning processes, making it vitally important to understand how teachers can support and enhance their students' development of agency. This study is a part of a design-based study introducing a dialogic approach to teaching and learning with the aid of technology. The empirical data comprise video-observations from classrooms and interviews with the teacher and students that we analysed using interaction analysis. The results show how teachers may practice specific dialogic moves, such as asking open questions and acknowledging students' contributions. Further, we show how technology may be used to position student contributions as a central focus point in the dialogue. This paper explains why these strategies work by pointing out interrelations between agency, positioning and dialogue. We emphasize both individual and social aspects of agency and show how they are intertwined.

1. Introduction

The impact of classroom talk on the standards of attainment has been thoroughly documented in recent research (Howe, Hennessy, Mercer, Vrikki, & Wheatley, 2019; Alexander, 2012; Murphy, Wilkinson, Soter, Hennessey, & Alexander, 2009; Nystrand, Gomoran, Kachur, & Prendergast, 1997; Mercer, Wegerif, & Dawes, 1999). In addition, research on dialogic teaching shows the importance of high-quality classroom interactions on student learning (Alexander, 2008; Mercer & Littleton, 2007). However, more knowledge is needed in relation to the details of classroom practices, such as how interactional moves and the use of technological tools can mediate student engagement in learning processes.

The probability of elaborated student talk increases correspondingly to the number of students who participate (Sedlacek & Sedova, 2017), and for students to actively participate in classroom activities, they need to have the agency to do so. They need to believe that their engagement matters and that they actually can influence classroom interactions (Doyle, 2015). Therefore, this study will investigate the relations between agency and dialogic teaching. Based on previous contributions, agency is defined as the socioculturally mediated capacity to intentionally initiate action (Ahearn, 2001; Giddens, 1984; Godwin & Potvin, 2017; McAdams, 2013). As a precondition for engagement, agency is fundamental for learning.

In the process of developing classroom agency, the teacher's role is essential. One central aspect of this is the strategies the teacher uses to engage students in classroom conversations (see e.g. Greeno, 2002; Snell & Lefstein, 2017; Wortham, 2004). Teachers can strengthen their students' agency by inviting participation (Clarke, Howley, Resnick, & Rosé, 2016), and they can change students'

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perceptions of their positions in the classroom by including or excluding them in whole-class conversations (Black, 2004; Snell & Lefstein, 2017; Wortham, 2004). Thus, it is crucial to investigate how the teacher's interactional moves influence the students' patterns of participation.

New technologies provide new tools that may alter teachers' and students' classroom practices. Such tools have been shown to facilitate classroom dialogues (Gao, Luo, & Zhang, 2012; Thoms, 2012). For instance, microblogs and digital whiteboards can initiate conversations and support collaborative learning and reflection (Major, Warwick, Rasmussen, Ludvigsen, & Cook, 2018; Mercier, Rattray, & Lavery, 2015). Microblogs have also been shown to open new opportunities for the orchestration of discussions, questioning and elaborations of students' contributions (Rasmussen & Hagen, 2015).

Comprehensive studies have researched classroom interactions and strategies for dialogic teaching (Alexander, 2012; Mercer et al., 1999; Mercer & Littleton, 2007; Reznitskaya et al., 2001). However, few studies connect these interactions with how the teacher positions students and the students' development of agency. Even fewer have investigated how such interactions may be mediated by technology. In this article, we explore how the building of agency through dialogic moves, positioning and technology mediation can contribute to explaining why and how dialogic teaching can support student learning. We examine how dialogic teaching, positioning and agency are intertwined and show why examining them in connection is important to developing dialogic teaching strategies. Through the analysis of one teacher's practice, we highlight technology mediated strategies that may build student agency and dialogic participation. The aim is to understand the meaning and role of teachers' dialogic moves, acts of positioning and technology mediation in the promotion of student agency and thus to help explain one aspect of how dialogic teaching mediates students' learning processes.

2. Theoretical framework

2.1. Dialogic teaching

The quality of whole-class conversations and group discussions influences students' learning and reasoning. When students are taught to think together, classroom dialogues may become tools for developing new understandings and insights (Littleton & Mercer, 2013). What constitutes educational dialogue and how the concept should be conceptualised is still discussed among researchers (see e.g. Brugha et al., 2018; Kim & Wilkinson, 2019). Our understanding is rooted in the sociocultural tradition, and language is viewed as the most important tool not only for communication but also for creating meaning and new understandings (Vygotsky, 1978). Humans create meaning in interactions with other people and the culture they are part of, and thus knowledge is viewed as shared and understandings as jointly constructed (Säljö, 2010). Meaning cannot be reduced to the utterance of the speaker or to the interpretation of the listener but emerges from the context between them (Bakhtin, 1986). As such, meaning is constructed and reconstructed in particular situations.

Our understanding of dialogic teaching follow the tradition of Nystrand et al. (1997), Alexander (2008) and Mercer and colleagues (e.g. Mercer et al., 1999; Mercer & Littleton, 2007; Mercer & Wegerif, 1999) in which dialogic teaching points to how the quality, dynamics and content of talk is facilitated by the teacher. Classroom dialogue is characterised by the meeting of different voices that are explored, compared and confronted in conversations (Alexander, 2008). For such dialogues to take place, students need to learn how to build on each other's contributions, to elaborate and to ask for justifications (Hennessy et al., 2016; Mercer et al., 1999). Opinions should be sought but also challenged (Mercer & Littleton, 2007). A prerequisite for dialogic teaching is that the teacher masters a wide repertoire of strategies for using language as a tool for learning (Alexander, 2008; Mercer & Littleton, 2007). Such strategies are discussed in the review section of this article.

2.2. Agency

For productive dialogues to take place, students need to actively engage themselves, and a precondition for such engagement is agency. Different traditions and scholars have interpreted the concept of agency in various ways (Eteläpelto, Vähäsantanen, Hökkä, & Paloniemi, 2013; Matusov, von Duyke, & Kayumova, 2016). Agentic students are viewed as persons that intentionally pursue their goals and plans (Ahearn, 2001; Clarke et al., 2016; Giddens, 1984). We want to highlight that agency comprises both (a) the social structures that may influence the individual's possibilities to act and (b) the individual's perceived capacity to act (sense of agency) (Hilppö, Lipponen, Kumpulainen, & Virlander, 2016; Mäkitalo, 2016). The social dimension of agency (a) is comprised of the constraints and possibilities in the situation (Holland, Lachicotte, Skinner, & Cain, 1998). We use Hilppö et al.'s (2016, p. 51) conceptualisation, and refer to *sense of agency* (b) as 'the individual's subjective awareness of being an initiator or executor of actions in the world'.

This duality of the concept reflects the sociocultural perspective in which agency is perceived as situated, socially constructed and continuously negotiated and renegotiated. In this article, the focus is the classroom, where *sense of agency* refers to the student's perceived capability to influence classroom activities. The *social dimension* refers to the classroom environment, which is mediated by the teacher, other students, the school, social norms and the governmental curriculum. For agency to result in enactment, one needs to have agency on both an individual and a social level. In the classroom, the students' actions (e.g. how they choose to participate in classroom talk) constitutes *enacted agency*. We consider it enacted agency when students share their own opinions, attitudes and beliefs in conversations or when they use their influence to alter the direction of a conversation (Martin, 2016). As agency is viewed

as socioculturally constructed, the classroom environment becomes the setting in which the students enact agency. The teacher's role in developing this as well as in mediating the students' agency to play a productive part in these activities are vital for the students' development as learners.

2.3. Positioning

A central aspect of agency is the power to influence or even change one's surroundings (Doyle, 2015; Godwin & Potvin, 2017; Martin, 2016; McAdams, 2013). As this is closely related to authority and power relations in human activity and learning (Rajala, Martin, & Kumpulainen, 2016), we will use the term *positioning* when examining this aspect in our analysis. Positioning describes how relations between people are negotiated through interactions and is a metaphorical reference to an individual's 'relations of power, deference and entitlement, social affiliation and distance' (Holland et al., 1998, p. 127). Positions are not permanent and may even be local or momentary. They become apparent through discursive processes and may be negotiated so that a person may be repositioned with a new status (Holland et al., 1998). In the classroom context, positions may be negotiated through the distribution of talk. How teachers engage students in classroom talk contributes to positioning students with different dispositions for future participation (Martin, 2016; York & Kirshner, 2015). The way teachers invite and respond to students' contributions thus becomes decisive. In the following, studies are presented that have investigated teaching strategies in relation to dialogic participation and agentic behaviour.

3. Review

3.1. Teacher–student interactions, agency and positioning

Multiple studies have investigated how the interaction between students and their teacher may influence the students' participation behaviours (e.g. Black, 2004; Black & Varley, 2008; Clarke et al., 2016; Rajala, Kumpulainen, Rainio, Hilppö, & Lipponen, 2016; Snell & Lefstein, 2017). This research has suggested central strategies to enhance agentic participation. A teacher's initiative to engage students in discussion may alone increase students' participation. Clarke et al. (2016) found that when the teacher asks a student to contribute early on in a lesson, the student more readily initiates participation later in the same class. Clarke et al. (2016) dubbed this the 'echo-effect'. In addition, they noted that teachers could increase students' agency to participate by making the students feel that their participation is a valuable contribution.

Students may learn more when teachers display their own thinking, reflection processes and mistakes than when they teach more traditionally (Olitsky, 2006). Furthermore, such practices may reduce the distance between the teacher and the students because the teacher is positioned as a curious learner, and in this way, the teacher is modelling learning behaviour. In some situations, teachers may even frame the students as the experts and themselves as learners and thus credit their students' authority while recognising their contributions (Lipponen & Kumpulainen, 2011).

Teachers may also enhance students' agentic behaviour by letting them explore new topics based on their prior knowledge and interests (Basu, 2007; Rajala et al., 2016); Siry, Wilmes, & Haus, 2016). Greeno (2002) noted that allowing students to 'generate questions and problems that become topics for the class' (p. 5) and 'positioning students by identifying them as authors of conjectures and explanations' (p. 7) might encourage students to contribute to the classroom community. Lipponen and Kumpulainen (2011, p. 816) emphasised this aspect, arguing that 'getting your ideas through and, especially, seeing them having practical implications, should give the learner a true sense of authority and agency'. Clarke et al. (2016) referred to the case of one student who began as a low contributor but whose participation pattern changed after one episode in which they discussed a subject of which she was knowledgeable. She articulated that her contributions during this class made her 'become smart for a day' (p. 36). The authors observed that her pattern as a low contributor changed after this lesson, and they connected this shift to a change in her perception of self. This research combined shows that the way teachers position their students' prior knowledge is important for the students' sense of agency.

3.2. Dialogic moves

Important factors in developing agentic student behaviour are the interactional strategies the teacher uses in classroom conversations. Two such strategies are *open questions* (questions without predefined answers) and *uptake* (when one interlocutor asks another about something the other person said previously) (Nystrand et al., 1997). Nystrand, Wu, Gamoran, Zeiser, and Long (2003) found that these moves may open the classroom to the students' ideas, allowing students' answers to change the trajectory of the lesson. Black and Varley (2008) found that employing an enquiry-driven pedagogy where students were asked open questions made students recognise learning as 'a process of trial and error, evaluation and collaboration' (p. 220). They also found that these strategies created a sense of community among the students. Snell and Lefstein (2017) found that the way a teacher performed uptake of students' contributions by asking for elaborations and not giving them the opportunity to avoid answering questions in class contributed to positioning them as authoritative, accountable and competent members of the class.

Howe et al. (2019) found that asking for elaborations was positively associated with curriculum mastery. In their study, the code *elaboration* referred to both invitations for elaborations (e.g. 'Have you noticed anything else'?) and actual elaborations, which included building on, elaborating, evaluating or clarifying their own or others' contributions. Asking for elaboration is one approach

to doing uptake of a contribution.

Michaels and O'Connor (2015) pointed to *talk moves* as strategies teachers may use to orchestrate academically productive discussions. Talk moves are utterances the teacher can use to obtain more extensive answers (e.g. 'Can you say more'? and 'Can you give us an example'?) or to press for reasoning by asking for justifications (e.g. 'Why do you think that'?). These moves have obvious similarities with invitations to elaboration. Another such move is *revoicing* (O'Connor & Michaels, 1996). This refers to how teachers can rephrase a student's utterance so that it becomes clearer and better phrased than the original one. When a teacher revoices, there is an implicit (or explicit) question directed towards the student in the rephrasing to ensure that it covers students' meanings. If the student confirms the rephrasing, the student implicitly receives ownership of it. Michaels and O'Connor (2015) argued that such talk moves can help change the nature of classroom talk from a traditional IRE-structure (initiation-response-evaluation) to discussions in which students have the responsibilities for explaining, justifying, critiquing and improving ideas. Thus, talk moves change the students' positions and responsibilities in the classroom.

Similar to talk moves, Snell and Lefstein (2017) showed how the probe 'tell me more' makes it easier for students to elaborate because there is no single correct response. Furthermore, they emphasised the importance of giving students a sufficient amount of time to think of an answer. This claim is supported by considerable previous research (see e.g. Black, Harrison, Lee, Marshall, & William, 2003; Cazden, 2001).

The term *dialogic moves* has previously been used to describe strict codes, which have been investigated in relation to productive classroom dialogues (Vrikki, Wheatley, Howe, Hennessy, & Mercer, 2019). In this article, it is used to describe the abovementioned strategies that previous research has shown to enhance classroom dialogues. Thus, *dialogic moves* refers to discursive acts that may serve to increase dialogic participation.

3.3. Technology aided classroom talk

We have seen how teachers can influence their students' agency through interactional patterns. Several studies have suggested that such processes may be aided by technology. Interactive whiteboards may facilitate joint attention to a shared text or contributions in classrooms (Mercer, Hennessy, & Warwick, 2010). Thus, they may function as a basis for further discussions, thereby grounding and sustaining engagement (Gillen, Staarman, Littleton, Mercer, & Twiner, 2007; Mercer et al., 2010). Furthermore, research has revealed that microblogging can initiate conversations (Gao et al., 2012), increase interaction and bring in new information (Thoms, 2012). Rasmussen and Hagen (2015) showed that sharing microblogs can place students' contributions at the core of classroom activities by displaying students' interpretations dynamically to the whole class and can allow the whole class discussion to elaborate on key elements from the work of several student groups. As technology may be a fruitful aid in classroom interactions (Major et al., 2018) and is increasingly a central part of everyday classrooms (Gilje, 2017; Rasmussen & Ludvigsen, 2010), we want to investigate how teachers can use technology as a tool in interactions to support students' agency.

3.4. Research questions

For productive classroom dialogues to unfold, students must participate and offer their opinions and viewpoints; in other words, they have to enact agency. Previous research has identified teaching strategies that may contribute to enhancing students' agentic participation. However, why and how such strategies work requires more research. In this study we try to give some answers to this by pointing to the connections between dialogic teaching strategies, agentic participation and positioning. We also examine how technology may mediate the dialogic learning process. We will address the following research questions: How can teachers enhance students' agency through (a) dialogic moves, (b) the attentive use of positioning and (c) technology-aided teaching?

4. Methods

4.1. Project and materials

The teacher whose practise is the focus of this study participated in the research project *Digitalised Dialogues Across the Curriculum* (DiDiAC). This project was a collaboration between the University of Oslo and the University of Cambridge and 22 teachers in Norway and England. The aim was to develop teaching practices that combined dialogic teaching (https://thinkingtogether.educ.cam.ac.uk/) with a microblogging tool called Talkwall. Talkwall was developed to support classroom talk. A task or a question is posed through the tool, and participants can post short contributions of up to 140 characters. All the contributions become visible for the participants in a 'feed', and the students or the teacher can choose to add the contributions to a wall. The wall allows for different ways of sorting the contributions. On a class screen, such as an electronic whiteboard, the teacher's or the individual students' walls can be shared with the class.

The data material consists of video recordings of lessons during which the teachers implement dialogic teaching and Talkwall, audio recordings of meetings between teachers and researchers and of interviews with the teachers and student focus groups, as well as logs from the microblogging tool. A more detailed description can be found in Appendix A.

4.2. Selection and thematic analysis

The recorded lessons were first analysed through a minute-by-minute categorisation of ongoing activities as either group, whole-class, interactive or non-interactive (Scott, Mortimer & Aguiar, 2006). Through this analysis, the lessons of the teacher whose practice is investigated in this study were distinguished by having frequent activity shifts between group and whole-class activities and being highly interactive. Such variations may reflect the active use of technology and dialogue as opposed to longer sequences of monologic discourse and indicate a broader repertoire of approaches, which are requirements for dialogic teaching (see e.g. Alexander, 2008; Mercer & Littleton, 2007). Observations over a longer period of time from the researchers present in the research lessons indicated that a high number of students participated in whole-class activities. Based on these observations, we wanted to investigate this teacher's strategies in more detail, and chose to conduct a case study (Yin, 2014). The objective was to explore the interactions by analysing the teacher's and the students' moves turn-by-turn in order to understand how the teacher created space for the students' agency to develop.

We conducted a thematic analysis (Braun & Clarke, 2006, 2012) on all the recorded lessons with this teacher, as well as on the interviews with the teacher and the students. The video recordings were viewed several times, and selected episodes were discussed with co-researchers. This work confirmed the perception of active student participation, and it led attention towards the ways in which the teacher invited the students into whole class talk. The recordings were then viewed again, and thematic patterns where inductively recognised by watching episode by episode while focusing on the interactions. The main categories that emerged from this work were the teacher's moves to acknowledge students' contributions, ask for elaborations, coordinate students' contributions, include students, ask questions as wall as her use of Talkwall. The main categories that emerged from the analysis of the audiotaped interviews were student participation, inclusion of students and how students related to other students' contributions on Talkwall and to other students' comments on their contributions.

Based on this preliminary analysis, one particular lesson was chosen for closer analysis. The entire lesson was orchestrated as discussions in which the teacher let students' contributions guide the evolvement of the lesson. The topic of the lesson was also chosen from a student contribution. We hypothesised that such placing of the students' contributions would support the development of students' agency (Clarke et al., 2016). We have focused on whole class conversations to investigate how the teacher-student interactions can contribute to building the students' agency. Naturally, these interactions are more dominant in whole-class conversations than during group work.

4.3. Analytical approach

In our further analysis, we used video-based interaction analysis (Derry et al., 2010; Jordan & Henderson, 1995; Mercer, 2004). After repeated viewings of the selected video-recorded lesson as a whole, we focused on the interactional processes in the whole-class sessions to investigate how the teacher invited and followed up on students' contributions through different dialogic moves. Furthermore, we identified episodes where she positioned either herself or the students in a way that we interpreted to influence the students' agency or in which Talkwall was used to mediate the students' contributions as central to the development of the lesson. Against this background, a selection of interactions (Enqvist-Jensen, Nerland, & Rasmussen, 2017; Furberg, Kluge, & Ludvigsen, 2013) that illustrated how she enhanced her students' agency by following specific words and concepts was analysed. In the analysis we have included the use of Talkwall as part of the interactions to investigate the role of this technology as an integrated part of the broader classroom practices.

Selected episodes from the interview material were included in the analysis as determined by the thematic analysis. We chose to include episodes in which the students discussed their uptake of the teacher's dialogic moves and demonstrated a sense of agency. The student interviews were done in focus groups in the form of student–student interactions. This material supplements the classroom observations because it offers insight into students' reflections regarding what happened in the classroom and their sense of agency. As such, it adds richness to the data.

In our analysis we had a special focus on how the teacher's use of positioning and the dialogic moves described in the review (uptake, open questions, asking for elaborations, revoicing and giving students sufficient time to think out an answer) influenced her students' agency.

5. Findings

5.1. The class and the lesson

The students in this study attended an eighth grade class in a lower secondary school (age 13/14) located in one of the largest cities in Norway. The class consisted of 27 students (15 boys and 12 girls). During the lesson in which the analysed interactions took place, the class was discussing impacts of the Industrial Revolution on society. Students had some background knowledge as they had previously worked with this topic.

An important characteristic of this teacher's strategies was that she allowed the topic of her lessons to evolve from the students' contributions by altering between group discussions and whole-class sessions using Talkwall as a tool to mediate the transition

between the activities. The lesson studied included five group activities and six whole-class sessions. Appendix B shows an overview of the lesson structure. Students worked in groups of three or four, with each group sharing one computer.

5.2. Interactions

5.2.1. Building agency by asking open questions, asking for elaborations and positioning students with authority

The teacher began this lesson by asking the students to discuss the societal consequences of inventions from the Industrial Revolution in groups. Then, she asked the groups what they had discussed.

Transcript 1:

Turn	Speaker	Action
1	Teacher:	You three, what did you talk about?
2	Imen:	We talked about the telegraph. Because it does have a consequence, because it has been developed to cell phones, and nearly everybody uses cell phones now.
3	Teacher:	Mhm. Why is that so important for the development of society?
4	Imen:	((Whispers inaudible to Amina))
5	Amina:	Not exactly on society, but without a phone it would not have been so easy to wo::rk with different stuff.
6	Teacher:	It is easy to work?
7	Amina:	((Nods))
8	Teacher:	And how does that influence society?
9	Amina:	Not so much, but (…)
10	Teacher:	No, ok? (…) Telegraph, the girls remembered. Can you take a look at the telegraph, everybody?

The teacher initiated this sequence with an open question, asking the students to tell her what they talked about (T1). Imen named the telegraph and the telegraph's further development into the cell phone (T2). Her addition of 'and nearly everybody uses cell phones now' can be interpreted as an attempt to name a consequence on society. Rather than evaluating the response as right or wrong, the teacher asked for further elaborations regarding *why* this was important for the development of society. In response, Amina, another member of the group, stated that work would not be as easy without cell phones. Initially, she seemed to doubt her own answer, saying, 'Not exactly on society' (T5). Rather than responding to this hesitation, the teacher revoiced the student's answer, asking, 'It is easy to work'? (T6). She may have been making sure she had heard Amina correctly, or she may have intended to give her the possibility to elaborate. When her question was confirmed by nods (T7), she asked for even further elaboration: 'And how does that influence society'? (T8). Amina did not elaborate further but only answered, 'Not so much' (T9). The teacher then stopped questioning this group, but she did not abandon the question. Instead, she turned it into an assignment for the next group discussion, asking students to discuss the impact the telegraph has had on society. This became the topic for the entire lesson. In this way, the teacher made the whole class reflect further at the point where the group in question ended its reasoning (T10).

The open question 'What did you talk about'? that initiated this sequence allowed the students to contribute anything they might have known about the subject. Answers to this question cannot be evaluated in terms of right or wrong, and the teacher avoided such evaluations throughout the dialogue. Instead, she gave signs that she was listening carefully, using dialogic moves such as 'mhm', revoicing the student's utterance and asking for elaboration. When it seemed that the students in the group could offer no more elaboration, she used their contribution as a new task, thus constricting the original topic and giving the lesson a new framing. In this way, the teacher positioned the students with authority to contribute to the evolvement of the lesson. By letting the rest of the class respond to the task, she positioned them with the opportunity to elaborate.

This transcript shows how this teacher asked students to elaborate their viewpoints and to discuss them in the following conversations and tasks. Using this strategy rather than evaluating their utterances, she build students' agency partly by positioning them with the power to influence and to define the evolvement of the lesson and partly by treating their utterances as valid for further conversation.

5.2.2. Building agency by giving probes, positioning the students with authority and through the aid of technology

Following the above interaction, the class discussed the societal consequences of the telegraph in groups before they (a) posted the discussed consequences as contributions on Talkwall and (b) sorted each other's Talkwall contributions as either advantages or disadvantages, each group making its own wall using the tool. While discussing each other's digital walls in a whole-class conversation, the option of placing contributions in the middle as neither advantages nor disadvantages presented itself. This placement was not part of the teacher's assignment and was a student construction. The students' walls were presented on a shared whiteboard that everyone could see. The following transcript is from a sequence in which the teacher asked the students to justify their sorting of the other groups' contributions on Talkwall based on the preparations they had made in their prior group discussions.

Transcript 2:

Turn	Speaker	Action
1	Teacher:	You, yes. Eh::: and you placed this in the middle. 'The telegraph developed to the cell phone, and nowadays nearly everybody has a phone which they are dependent upon' ((reading the post from Talkwall)). (…) Yes, why did you place this in the middle? (…) Why is it, I then think it is both::, both disadvantage, and, and (…) e::h advantage. Inaya?
2	Inaya:	Since everybody has one, you may, like, communicate with each other through it.
3	Teacher	Mhm
4	Inaya:	But, then again it is (…) disadvantage, because of you being dependent on it.
5	Teacher:	Mhm
6	Inaya:	That is, use it too often, so that you do not concentrate so much on things around you.
7	Teacher:	Mhm
8	Inaya:	Even though, you, like, have it ((whispers))
9	Teacher:	Yes. (…) Anybody else? Anything to say about that? (…)
10	Teacher:	We shall have a look at the other wall. And it is one more in the middle, 'you get less social physically, but more social on the internet'. Why is it both, and it is also Bit ((the name of the group)) that has written this (…). Why do you get (…), why is it both a disadvantage a:nd, and an advantage:: Anya (…), Haron and Jaamal and Inaya. (…) What did you talk about, Anya? (…) When you placed it in the middle?
11	Anya:	Eh
12	Teacher:	You get less social physically, more social on internet (…). Why is that both disadvantage and (…), a:::nd (…)
13	Anya:	Eh, because
14	Teacher:	And then of course we are talking about consequences of the telegraph, or further developments, yes (…)
15	Anya:	So, it's like a bit negative (…)
16	Teacher:	Is it negative?
17	Anya:	Yes.
18	Teacher:	Yes, why?
19	Anya:	Because when you just stay on the phone (…) that's not social (…)
20	Teacher:	It is not social on the phone?
21	Anya:	Yes, you are social on the phone, but you are like, not social with others (…)
22	Teacher:	Yes, why is it important to be social physically (…). Yes, Inaya, help Anya.

This transcript opens with the teacher asking Inaya why they had placed one specific Talkwall contribution in the middle, interpreting that they viewed it as both an advantage and a disadvantage (T1). Inaya answered right away, pointing out one reason why mobile phones may be viewed as an advantage (T2). The teacher's reaction was 'mhm' (T3), which was a response she used frequently. The sound 'mhm' was long-drawn, the intonation was soft and the tone had a higher pitch at the end. In the context of the Norwegian language, this would give the impression that she was reflecting thoughtfully. In the following, this particular use of the utterance 'mhm' is referred to as 'pensive'. Inaya then pointed to a disadvantage (T4–T6). Again, the teacher gave a pensive 'mhm' (T7), and she also made this sound while Inaya was speaking (T5). These pensive 'mhm' sounds seemed to lead Inaya on so that she elaborated on her answer. When Inaya stopped speaking, the teacher uttered 'yes' and paused. Inaya did not say anything else. Rather than responding further to Inaya's answer, the teacher asked the class if they had anything to add (T9). In this way, she positioned the students with the authority to elaborate on Inaya's utterance. When nobody accepted the opportunity, she moved on to another wall (T10).

The teacher initiated the next conversation (T10–T22) by reading the group's Talkwall contribution aloud and asking about its placement. She started out (T10) with several unfinished sentences, moving between explaining and formulating the question. While this might initially seem unclear or confusing for students, we argue that by allowing herself to structure her thoughts out loud, the teacher is modelling reflection and thinking processes for the class. She closed this process by asking the same open question as in Transcript 1: 'What did you talk about'. Next, she specified 'when you placed it in the middle'? (T10). We interpret this utterance as the teacher's acceptance of the students' way of responding by placing contributions in the middle rather than as positive or negative consequences. She allowed their way of reasoning to lead the discussion, now asking them to justify by explaining both the positive and the negative aspects of the invention. Despite this acceptance, this question seems less open, and she interrupted Anya's answer twice by elaborating even further (T11–T14) before letting her answer (T15). The answer she finally received was short and not very elaborate (T15). The teacher then revoiced Anya's answer (T16) and received a confirmative 'yes' in response to this (T17). She then probed Anya to elaborate using the dialogic move 'Why'? Anya elaborated (T19) before the teacher once more revoiced her answer (T20), which led Anya to confirm the teacher's revoicing and then to elaborate even further (T21). Despite Anya's initially short and hesitant answers, the teacher positioned Anya as a competent member of the class by probing for elaborations and revoicing her utterances. Thus, she showed both Anya and the other students that Anya's opinion was valid and important.

Transcript 2 also shows how this teacher used Talkwall as an integrated part of the classroom ecology using two strategies. In the first strategy, Talkwall mediated a process in which the students' contributions were used as central structures in the orchestration of the lesson. Prior to this excerpt, the teacher used Talkwall to support the students' group conversations by asking them to post the advantages and disadvantages of the telegraph and then to sort each other's contributions, making their own walls. In this way, Talkwall showed the results of their talk, mediating between group- and whole-class conversations. After the group work, the teacher narrowed the students' selections further, using students' sorted walls as a starting point for new dialogues and discussions. Talkwall allowed the teacher to use the students' contributions as the core of the lesson at different stages: at the outset when they produced them and as the foundation of the lesson during discussions. This use of Talkwall gave purpose to the students' contributions. They

became resources that provided substantial content to the lesson. Such placing of students' contributions facilitates agency because the students' participation becomes decisive for the lesson evolvement.

The second strategy concerns how the teacher positioned the students by using their Talkwall contributions. In T1and T10 (Transcript 2), the teacher recognised the placement of the contributions in the middle as a statement of both an advantage and a disadvantage. In the interactions between Transcripts 1 and 2, the teacher asked the class about this student-generated strategy. Rather than correcting the students for not following her instructions, the teacher asked the students to explain their actions. Transcript 2 offers an example of this elaboration. By placing the posts in the middle, the students enacted agency. They followed their own mind and went beyond the teacher's instruction. We argue that the way the teacher responded to the students' choice of action supported their agency. She accepted the way the students turned the direction of the conversation through their placement, thus positioning them with the power to make such turns.

Transcript 2 demonstrates how this teacher engaged her students in classroom dialogues in a way that enhanced their agency to participate. In Transcript 2, she invited students to partake by using several dialogic moves. She asked them open questions and encouraged them to continue their reasoning with her pensive 'mhm' sounds. She also positioned students who answered hesitantly as competent members of the class by asking them to elaborate and by revoicing their utterances. She also strengthened her students' agency by positioning them with the power to influence and partly to choose the direction of the classroom conversation. Talkwall mediated this process by making *all* student contributions visible to the rest of the class, making them content resources that became the focus point of their joint attention. The teacher also enhanced their agency by positioning the students with the opportunity to change her instruction and to develop their assignment.

5.2.3. Building agency through positioning by partaking on an equal level and allowing the students' contributions to lead the conversation

The teacher allowed the discussion about the Talkwall post concerning the development of the telegraph into the cell phone to continue for some time. The discussion evolved and drifted in the direction of communication not only related to cell phones but also to online and social media. The conversations in the following transcript took place 1 min after the one in Transcript 2. The teacher asked another group where they placed the same contribution, following the same trajectory as in the previous excerpt.

Transcript 3:

Turn	Speaker	Action
1	Teacher:	Can you take a look at the post? Where have you placed it (…). On disadvantage or advantage?
2	Eric:	On disadvantage.
3	Teacher:	Disadvantage. Why have you placed it on negative, Eric?
4	Eric:	It's like, better to talk to someone.
5	Teacher:	Why is it better? (…)
6	Eric:	You know each other better. So, then you know who the person is.
7	Teacher:	Mhm, mhm
8	Eric:	But then you don't know, could be, like, someone else.
9	Teacher:	Yes, it could be someone else, right, you don't see, you could have a totally different identity. Mhm (…). That is an important point (…), of course. Aisha?
10	Aisha:	Like, it's better to talk face to face than, like, through the screen, because you could like (…)
11	Jibril:	You communicate better.
12	Aisha:	Yes, you communicate better, and like, people are like, they don't dare to say it in your face, but dare more easily to the screen and so on.
13	Teacher:	Mhm. Yes.

This sequence opened with the teacher asking one group about their sorting of the previously discussed Talkwall contribution (T1). After being told the group's placement, she asked Eric to justify his group's decision (T3). He answered (T4), and the teacher led him to elaborate further, first by asking him to justify (T5) and then by uttering her pensive 'mhm, mhm' (T7). Eric argued that it is better to talk with people in person because then 'you know who the person is' (T6, T8). The teacher then elaborated on Eric's answer herself by first rephrasing his answer and then adding, 'you don't see; you could have a totally different identity' (T9). Here, she took part in the dialogue by building on Eric's comment and adding a point that drove the dialogue further. By doing this, the teacher positioned her utterances as equal to the students' in the classroom dialogue. This was also indicated by the next student's contribution. Aisha built on the teacher's utterance, adding that it is better to talk face-to-face (T10). When attempting to justify this, she struggled for words, and Jibril elaborated for her, saying, 'You communicate better' (T11). Aisha confirmed that this was what she meant and went on to elaborate even further (T12). Aisha enacted agency by elaborating on her own initiative and giving her opinion. She also recognised Jibril's agency by accepting his contribution to her own utterance.

In this transcript, the teacher uses several dialogic moves, such as asking for elaborations and justifications and using the pensive 'mhm'. Her way of orchestrating the dialogue becomes a recognisable pattern in the interactions. Through her pensive 'mhm', she models thinking strategies and shows that she reflects upon the students' utterances. Their uptakes (T7, see also Transcript 2: T4, T6 and T8) show that the students recognise this move as a probe to continue their reasoning. We argue that this manner of interacting has become a part of the classroom culture.

The exchange shown in Transcript 3 also demonstrates how both the students and the teacher drove the dialogue by building on each other's utterances. The students built on each other's contributions by adding small details to the previous speakers' ideas. The

teacher served as a facilitator by orchestrating the dialogue, but she also partook in the conversation at the same level as the students (T9). Thus, (as in Transcript 2, T10), she is displaying her own reflection and thinking processes, and in this particular setting positioning the students' contributions as equally relevant as her own. The students positioned themselves with the authority to drive the classroom conversation and thus showed enacted agency by building on each other's and the teacher's utterances. However, this enactment would not be possible without the teacher positioning them with the authority to do so. Again, the way the teacher allowed the students' contributions to lead and to turn the conversations is demonstrated.

5.3. Interviews

The analysis of the above interactions has shown that the teacher uses a range of strategies to engage her students in classroom discussions. During the interviews, the students talked about the teacher's strategies. The following conversations are from a focus group interview with four of the students:

Turn:	Speaker:	Action:
1	Amina:	The teacher is like, yes, but have you done that or, be a little more precise, or, be engaged.
2	Inaya:	Mhm. It helps when she gives such comments, then, then you understand.
3	Haron:	A lot, actually.

The analysis of the above transcripts have shown examples of a pattern of participation in which the teacher kept the students engaged in the dialogue by asking them to elaborate or giving them probes, even though they answered quite hesitantly initially (e.g. Transcript 1: T5 and Transcript 2: T15, T17 and T19). The students expressed that they found the teachers' probes helpful (T2), and they also stated that such probes made them understand 'a lot, actually' (T3). We argue that the teacher's support helps them build agency. Although they initially might have come to terms with not understanding, the teacher's way of questioning them, making them elaborate and letting them explore the questions in dialogues and through Talkwall helped them expand their understanding. The teacher herself commented on this situation during her interview:

> So, perhaps to ask these questions that promotes participation (…) sometimes we ask a question and don't get any answers or nobody knows, but just that they could write a little in advance and think a little and talk a little, that promotes the dialogue in the whole classroom.

Here, the teacher reflected that her strategies can promote dialogic participation, both with regards to her dialogic moves ('these questions') and through the way she allowed the students to prepare for whole-class discussions by thinking, talking to peers and writing in advance.

The students reflected on this process themselves:

Turn:	Speaker:	Action:
1	Inaya:	When we answer a question, it's like, now we have to remember what the teacher told us. Elaborate, but in which way? That we have to find out ourselves, but it's like, we try anyway.
2	Amina:	Yes. Yes.
3	Interviewer:	Yes.
4	Inaya:	And sometimes the answer isn't that long, but at least we try.
5	Amina:	At least we try.

These comments show that the students were conscious of how they worked with the questions the teacher gave them. They expressed that they knew they had to elaborate and to determine how on their own (T1). These utterances demonstrate a sense of agency; in particular, the students were conscious of having to reason for themselves. Although their answers might not be 'that long', they acknowledged that 'at least we try' (T4). These responses show that they have confidence enough to participate, even though they did not necessarily know how. This shows that the classroom culture is open for trial and error.

The students also reflected on the fact that other students built on their comments:

Turn:	Speaker:	Action:
1	Haron:	We have heard others say what we said. When they say, speak to the teacher.
2	Inaya:	Yes, it's like, they steal it in a way, but we don't get angry. We get like, wow, that was our contribution. We get so proud.
3	Amina:	Yes.
4	Haron:	Yes, it's nice. We get happy because it was so good.

These responses substantiate that the organisation of the classroom in which the teacher allows the students to build on each other's Talkwall contributions gave the students a sense of reward for their participation. They felt proud when someone used their

contribution in a conversation. We argue that this experience also strengthened the students' sense of agency because it showed the students that their contributions had impacts on others.

6. Discussion

The analysis of the interactions from the classroom and the interviews has shown a teacher who practices a range of strategies that contribute to building her students' agency. She uses several dialogic moves in which she positions the students as competent members of the class, and she uses Talkwall as a mediating tool for dialogue. This is orchestrated through frequent shifts in activities that allow her to move between group and whole-class activities. These variations provide the students with diverse opportunities to participate in group conversations, through Talkwall and in whole-class conversations. Research has pointed to teachers' varied repertoires in using language as a tool for teaching and learning as a key to dialogic teaching (Alexander, 2008; Mercer & Littleton, 2007). We will now discuss how this case study confirms and adds new insight into the understanding of productive dialogues.

To promote participation in these activities, the teacher in this study practices several dialogic moves. One of the most prevalent is asking open questions. As Black and Varley (2008) pointed out, open questions make it easier to participate because they have no right or wrong answer. Such questions encourage productive dialogues (Mercer & Littleton, 2007; Mercer & Wegerif, 1999; Reznitskaya et al., 2001). Using open questions the teacher orchestrates explorations in whole-class dialogues by asking the students to contribute with ideas and elaborations that can be built on and investigated further without an evaluation from the teacher.

Moreover, researchers have emphasised the importance of giving students enough time to think before they have to answer (Black et al., 2003; Cazden, 2001; Snell & Lefstein, 2017). Significantly, thinking time must occur without the pause being awkward for the student answering. This teacher used her pensive 'mhm' to allow students time to think. This sound often functions as an uptake of the student's utterance, and the follow-up may lie with the teacher or with the student. Sometimes the student—or another student—benefits from the pause, continuing the line of reasoning by elaborating; at other times, the teacher follows up with further questions or clarifications. Through this move, the teacher models that she reflects upon the students' utterances and opens space for them to think together. We have argued that this has become a part of the classroom culture. This interpretation is supported by the observation of this teacher's lessons over time as described in the methodology section.

Elaboration was the strategy that was most strongly correlated with learning outcomes in Howe et al.'s (2019) study. Invitations to elaborate permeate this teacher's strategies. We have seen how it was incorporated as a follow-up after open questions or after the pensive 'mhm'. Often, this teacher's invitations to elaboration take the form of revoicing. This move can enhance the quality of the student's phrasing and at the same time give the student the responsibility for the utterance. Invitations to elaborations generally place the responsibility for contributions with the student, positioning them as accountable members of the class. Previous research has also pointed out that mere invitations to participation can promote students' agency to continue to participate (e.g. Clarke et al., 2016).

For this to occur, the teacher's uptake of the students' contributions is crucial. The uptake can position students as either competent or marginalised in the classroom discourse (e.g. Black, 2004; Martin, 2016; Snell & Lefstein, 2017). In the analysis of the classroom interactions we have seen how this teacher through the different ways she performed uptake of her students' contributions, made them central to knowledge building. Her revoicing of her students' answers made them the objects of further investigation. In this occasion, she also built the entire lesson from the students' contributions, first by defining the topic of the lesson based on one group's answer and then by letting the lesson evolve through the groups' contributions on Talkwall. In the uptake of the students' contributions, the teacher combined dialogic strategies and the materiality of Talkwall.

The use of technological tools can support joint attention (e.g. Mercer et al., 2010), as for example when the class is involved in discussing one Talkwall contribution displayed on the classroom screen. The Talkwall contributions serve as a basis for further discussions (Gao et al., 2012; Gillen et al., 2007; Mercer et al., 2010) in both whole-class and group talk. The way the students are led to respond to and to sort other students' contributions increases interaction (see Thoms, 2012). This use of Talkwall makes the students' thinking process more transparent in the classroom and is a highly visible and powerful uptake of students' utterances (Rasmussen & Hagen, 2015). Through this way of performing uptake, the teacher positions the students as competent members of the class by showing them that their contributions are important, giving them the power to influence the evolvement of the lesson and letting their contributions lead the classroom talk. Talkwall is strongly embedded in and supports the teacher's dialogic practice.

For students to participate, they need to experience that their participation matters over time. They also need to have something to contribute. In this lesson, the class discussed consequences of the Industrial Revolution. The teacher's combination of open questions and relating to prior knowledge allowed the students to participate in subject-relevant ways, building on the knowledge they found relevant. Research has shown that letting students explore new topics based on their prior knowledge enhances students' agency (Basu, 2007; Clarke et al., 2016; Greeno, 2002; Rajala, Hilppö, Lipponen, & Kumpulainen, 2013; Siry et al., 2016). As the teacher commented in the interviews, Talkwall mediates this process by allowing the students to think and to talk in advance of the whole-class discussions, thus allowing them to be more prepared.

Another strategy this teacher uses to support her students in developing substance to their contributions, is modelling thinking strategies. Through the way the teacher pauses to think about the students' ideas, the way she is reflecting on their contributions and partaking in the conversations, she is making processes of reasoning explicit. She demonstrates that there is no given answer and that it is okay to participate without having thought everything through before entering one's contribution. By participating in the discussion in this way, she models learning approaches by displaying thinking strategies (Olitsky, 2006).The teacher positioning herself as a conversational partner strengthens the students' positions as competent members, and thus, their authority (Lipponen & Kumpulainen, 2011).

The way this teacher orchestrates her classroom facilitates the social structures in a way that enhances the enactment of agency. The frequent activity shifts and the activation of prior knowledge combined with the modelling of thinking processes help the students prepare for participation in whole-class discussions. In addition, her range of dialogic moves facilitates an environment that motivates agentic participation. Research shows that the social dimensions of the classroom influence students' sense of agency (Clarke et al., 2016; Doyle, 2015). As such, the individual and social dimensions of agency are intertwined (Clarke et al., 2016). In this study, we have performed detailed analysis of interactions that shows how a teacher can develop students' agency. The presented analysis shows how the students enact agency through dialogic participation by putting forward their own opinions, views and insights and occasionally shifting the classroom dialogue. The dialogues become a collaborative effort that move beyond direct instruction through the students' and teacher's moves. The interview statements support these findings, indicating that the students experience a strong sense of agency. In sum the analysis shows that the teacher supports her students' sense of agency through the way she facilitates the classroom environment with multiple strategies and dialogic moves.

7. Conclusion

Building on previous research and new empirical findings, this study shows how particular dialogic moves and acts of positioning can contribute to promoting students' agency. Few studies have investigated similar issues. Lipponen and Kumpulainen (2011) showed that through the creation of interactional spaces educators could change the positions of students and student teachers from the traditional expert-novice boundaries as well as mediate students' agentic participation. Clarke et al. (2016) found that positioning high school students as knowledgeable contributors in class could have a lasting impact on their sense of agency, and that by engaging students early on in one lesson, teachers could enhance their later agentic participation in the same lesson.

However, both of these studies were situated in different contexts than ours. Our study offers insight into the work of younger students, demonstrating specific strategies based on the teacher's understanding of the students capacities in the particular subject and situation. Furthermore, neither of the two mentioned studies have our focus on dialogic moves at a micro level. To fully understand how these strategies work, the broader practices of the teacher's instructional work must be considered. We show how several dialogic moves including the pensive 'mhm', open questions, asking for elaborations and revoicing, contribute to building agency. Through a detailed analysis of these moves and the students' uptake of them, we show how these interactions contribute to form a classroom culture in which agentic students are positioned as important contributors in dialogic explorations.

Further, the way Talkwall is integrated into the teacher's practices as a mediational tool for dialogue facilitates the use of productive dialogical moves. This use of technology is unique, and creates a trajectory where the students' contributions become the core resources in the construction of new understandings. The students are positioned with authority to define and to evolve discussions, and in this particular situation, even the topic of the lesson. By positioning her students' contributions as central to such an extent, this teacher creates a classroom culture with multitudes of opportunities for agentic participation.

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Appendix A. The project and the data material

The teachers participated in workshops organised by the researchers in which they were introduced to dialogic teaching and to the digital tool. The research team filmed one lesson before the intervention and three research lessons from each participating teacher. The lessons were filmed using two cameras, one focusing on the teacher and the other focusing on a group of students during group work sessions. Between the research lessons, teachers and researchers met to discuss the lessons in terms of dialogic practice and the use of Talkwall. The teachers and two focus groups with students from each class were interviewed towards the end of the project period.

The material from the teacher in this case-study comprised of two follow-up lessons in addition to the three core research lessons. These are lessons that addressed the topic from the core research lessons and that were chosen to be filmed in order to follow a thematic trajectory from introduction to closure. In total, there were five recorded research lessons from this teacher that this case-study follows. The lesson chosen for closer analysis is the 3rd of the recorded lessons, and it is one of the follow-up lessons.

After recording the research lessons, interviews with the participating teachers and student focus groups were conducted. Students who had been participating in the groups that were filmed by the group cameras were invited to participate. They were asked about their opinions regarding classroom talk and the use of Talkwall. The interviews were semi-structured, and the conversations sometimes moved beyond the questions asked.

Appendix B. Overview of the focus lesson

Minutes	Content description
	Greetings. The teacher asks the students about the last lesson, and they repeat what they talked about then. **Assignment 1:** The teacher asks students to discuss impacts of inventions from the Industrial Revolution in groups.
	Students discuss the assignment in groups.
	The teacher asks two groups about their discussions. The second one discusses the telegraph. **Transcript 1 is from this sequence.** **Assignment 2:** The teacher asks the groups to discuss the impacts of the telegraph on society.
	The students work in groups of two to four and discuss the assignment.
	Assignment 3: The teacher instructs groups to post on Talkwall their responses to: 'What did the telegraph do for society'?
	The groups create posts on Talkwall that discuss the impacts of the telegraph on society.
	Assignment 4: The teacher asks the class to sort each other's posts into positive and negative consequences in Talkwall.
	The groups sort each other's contributions.
	The teacher reads posts from the groups' Talkwall posts. The students comment on their own and other groups' contributions and sortings. **Transcripts 2 and 3 are from this sequence.** **Assignment 5:** The teacher asks groups to discuss the positive consequences of the fact that the telegraph made it easier to communicate with others and what impact this had on society.
	Students discuss the assignment in groups.
	The teacher asks the students what they talked about. She receives answers from different students. **Consolidation:** The teacher asks the students to summarise the lesson by giving three positive and three negative consequences of the telegraph.

Fig. 1. Overview of the lesson. Each of the squares in the first column represents 1 min of the lesson (of a total of 45 min). The white squares represent minutes used in whole-class conversations, and the grey squares represent group work. The second column provides a short description of the activities in the different sequences.

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Article II

Omland, Maren (2021). Technology-aided meaning-making across participation structures: Interruption, interthinking and synthesising. *International Journal of Educational Research, 109*, 101842

This article is published, but because the editorial production team is in the process of correcting errors, I submit the thesis with the last submitted version of the manuscript.

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Abstract

This article explores how specific discursive strategies in dialogic communication contribute to students' meaning-making. These strategies create meaning potential that teachers can exploit by combining different participation structures. As part of a design-based study introducing a dialogic approach to teaching and learning with the aid of technology, the article draws on empirical data comprising classroom video observations analysed using interaction analysis. The findings show how interruptions, interthinking and synthesising can constitute central discursive strategies in students' meaning-making and how the meaning-making potential of these moves can be exploited when technology is used to transmit contributions from group to whole-class dialogues. The analysed teaching method allows teachers to build on students' voices to reach valid knowledge using dialogic approaches.

Keywords

Dialogue, Technology-aided teaching, Meaning-making, Interthinking, Participation structures, Microblogs

Highlights

- Interruptions and the use of everyday language are important tools in students' productive interthinking.
- Interruptions, interthinking and synthesising constitute central discursive strategies in classroom meaning-making.
- Teachers can exploit this potential by using technology to transmit contributions from group to whole-class dialogues.
- Combining different participation structures allow teachers to build on students' voices to reach given knowledge.

1. Introduction

There is consensus that dialogue can be productive for students' meaning-making (Alexander, 2008; Howe et al., 2019; Nystrand et al., 1997). Although dialogic teaching and learning is broadly studied, what constitutes the concept in a classroom context is disputed (Brugha et al., 2018; Kim & Wilkinson,

2019). A central aspect of this dispute is to what degree talk can be regarded as dialogic if an interlocutor conveys the attitude that the discussed topic has a predefined answer (Reznitskaya & Gregory, 2013; Wegerif, 2008). In this article, Linell's (1998) definition of *dialogue* as 'interaction through symbolic means by mutually co-present individuals' (p.10) is followed. The term *dialogic* is used as an adjective to describe interactions with an inherent aim towards mutual exploration of topics and co-construction of new understandings. *Dialogic teaching* is used to describe teaching that strives for this aim through dialogue. The question of whether dialogic teaching can comprise predefined answers is for teachers often reflected in the dilemma between conveying topics specified in a curriculum and encouraging the exploration of students' views in dialogues (Mercer & Littleton, 2007; Scott et al., 2006).

As a combination of participation structures has been shown to engage a larger number of students than either approach used alone (Webb et al., 2019). This article aims to add to the above discussion by analysing group interactions where the students explore questions and whole-class interactions where the teacher guides the students. By focusing on discursive strategies used in meaning-making across participation structures, the article explores how combining group and whole-class interactions can solve the above dilemma and secure both explorations through dialogue and curricular goals.

When teachers navigate between different participation structures, technology can offer some support. Microblogging tools and digital whiteboards can mediate transitions between group and whole-class conversations (Frøytlog & Rasmussen, 2020), support collaborative learning and reflection and be used to initiate conversations (Major et al., 2018; Mercier et al., 2015). This study analyses a teaching design in which a microblogging tool was used to facilitate transition between participation structures.

The empirical material for this article consists of video observations from 10th grade students who had previously taken part in a design-based study introducing dialogic teaching supported by technology. A comparison of the transcripts from group and whole-class interactions revealed that the turns in groups were short with many exchanges between voices, whereas the turns in whole-class interactions often were long and exchanges much rarer. When investigating the implications of these differences, the concepts of interruptions (Nikulin, 2010), interthinking (Mercer, 2000) and synthesising (Wegerif, 2008) proved productive in describing how these differences influenced collective meaning-making. Even though these were found to be the most central strategies, the interlocutors also used other discursive strategies, such as questions, linguistic cues, uptake and coordination. In this article, the term

discursive strategies describe interactional tools that can be used to mediate collective meaning-making. The next sections will discuss central concepts that proved relevant when investigating the empirical material. The implications for dialogic meaning-making of specific discursive strategies used in group and whole-class interactions will then be explored through analyses.

1.1. Dialogue, synthesising, interruption and interthinking

Using the tool of language, we are able to help each other learn (Vygotsky, 1978) and co-construct meaning through dialogue (Bakhtin, 1986). Bakhtin (1986) described how every utterance in a dialogic sequence must be interpreted in a specific context and both previous utterances and the anticipation of further utterances must be taken into account. Thus, meaning cannot be reduced to either the utterance of the speaker or the interpretation of the listener, but emerges from the context between them and must be constructed and reconstructed in particular situations. In dialogues, multiple voices contribute to meaning-making that goes beyond the individual participant. For Wegerif (2008), to *synthesise* implies that one voice is positioned above others in search of consensus.

Yakubinsky (1997) described the role *interruptions* play in the shifts between utterances in dialogues, stating that "to a certain extent mutual interruption is characteristic of dialogue in general" (p. 250). He emphasised that our awareness that our interlocutor is preparing a response—which may include interruptions—influences our utterances. Furthermore, he pointed out the complexity of partaking in a dialogue by explaining that "we must listen to and understand our interlocutor's utterance *and* simultaneously prepare our response thematically and linguistically" (p. 251). This complexity explains why utterances in a dialogue are often sketchy and linguistically inadequate. Building on this notion, Nikulin (2010) described how interruptions bring "the interlocutors together into dialogical interaction not as incommensurable and isolated individuals but as dialogical partners" (p. 99). The "rupture" does not separate the interlocutors but unites them. Because we expect interruptions in a dialogue, they become indispensable in the exchanges where the interlocutors constantly are trying to understand and make themselves understood.

These theorists convey the idea that dialogue is the interplay of multiple voices and that meaning emerges between different positions in activities. The concept of *interthinking* (Littleton & Mercer, 2013; Mercer, 2000) describes how "people can combine their intellectual resources to achieve more through working together than any individual could do on their own" (Littleton & Mercer, 2013, p. 111). Thus, interthinking seems to cover the dialogic meaning-making described by the above theorists. The

interrelation between interthinking, interruption and synthesising will be explored during the analysis. In the following sections, studies investigating classroom dialogues across different participation structures will be discussed in order to discern the characteristics of such talk.

1.2 Peer talk

Peer talk can be productive for students' learning in several ways. Through peer talk, students can build new understandings on previous knowledge, which may deepen learning (Barton et al., 2008; Moje et al., 2004) and motivate students to examine problems by exploring their own views (Scott et al., 2006). Through such explorations, peer talk can serve to maintain a "dialogic space of reflection" (Wegerif, 2008, p. 358).

Researchers have described conditions that seem to promote productive peer talk. Barron (2000) pointed to *coordination* of thoughts as fundamental for establishing common ground. In activities where students are coordinated, they constantly monitor each other, play complementary roles in completing problems, and refer and respond to each other's ideas. Mercer and Littleton (2007) found that peer talk was most productive during interactions they described as *exploratory*, when students engaged critically and constructively with each other's statements. During such talk, thoughts should be challenged, but challenges are justified and alternative hypotheses offered. *Cumulative* interactions, characterised by accumulation, repetitions and confirmations, they found to be less productive (Mercer & Littleton, 2007).

Dialogues that allow students to explore topics and co-construct new understandings demand teacher facilitation and require time and practice (Gillies, 2016; Mercer & Littleton, 2007). In this article, teacher facilitation refers to interactional strategies such as different moves and distribution of speaking time, but it also comprises organisational means such as building a classroom culture for productive peer talk or developing norms for interaction. One such approach is to develop a set of local norms, or *ground rules*, for conversations (Edwards & Mercer, 1987). Giving students authority in addressing intellectual problems, making them accountable and giving sufficient resources have also been found to increase productive peer interaction (Engle & Conant, 2002).

1.3 Whole class interactions

One way for teachers to perform uptake of peer talk is through whole-class interactions. However, research has shown that this might be quite challenging. According to the accountable talk approach

(Resnick et al., 2018), a key in this process is valuing all students' contributions, including wrong ideas, because this promotes student participation and exploration of ideas (Clarke et al., 2016; Gresalfi et al., 2009). Furberg and Ludvigsen (2008) showed how the goal of producing an expected answer to an assignment may overshadow rich discussion and meaning-making amongst peers. They pointed out the importance of the teacher doing uptake of peer talk, not just the finalised product.

To discern characteristics of dialogic whole-class interactions, research has often contrasted such interactions with a more monologic approach to teaching (Alexander, 2008; Mercer et al., 1999; Nystrand et al., 1997; Scott et al., 2006). This research has frequently distinguished between these teaching approaches by pointing towards how different perspectives and voices are incorporated in the classroom discourse. In *monologic* classroom talk knowledge is treated as a fixed objective truth typically originating from the textbook or the teacher (Nystrand et al., 1997). In *dialogic* classroom interactions knowledge is treated not as a given, but as something that can be explored and examined. Students' voices are heard, and teachers may build conversations based on students' ideas (Resnick et al., 2018). During whole-class dialogues teachers often ask open questions structured to provoke thoughtful answers and generate information rather than to check what students know (Michaels et al., 2010). Teachers ask students for elaborations and justifications of ideas, and they explore and probe their students' views (Howe et al., 2019; Scott et al., 2006). This way of validating students' ideas may be described as *uptake* (Nystrand et al., 1997). Michaels and O'Connor (2015) pointed to *talk moves* as strategies to orchestrate academically productive discussions. Talk moves are utterances the teacher can use to obtain more extensive answers (e.g. "Can you say more?") or to press for reasoning (e.g. "Why do you think that?"). Boyd and Markarian (2011) argued that the teacher's *dialogic stance* – to which degree the teacher listens to, puts forward and uses students' contributions in classroom talk – is more important for classroom dialogue than practiced moves (Boyd & Markarian, 2011).

1.4 Technology

Used in specific ways, technology can mediate interactions (Major et al., 2018; Mercer et al., 2019). Interactive whiteboards may facilitate joint attention to shared text in classrooms (Mercer et al., 2010) by providing a base for further discussions and sustaining engagement (Gillen et al., 2007; Rasmussen & Hagen, 2015). Shared visualisations where students can rearrange ideas in physical space so that they can be juxtaposed, compared and synthesised support the process of novel combination and new interpretations (Martin & Schwartz, 2014, p. 87). Interactive whiteboards can serve as such

visualisations (Warwick et al., 2020) and may create a dialogic space for sharing ideas and co-constructing knowledge (Mercer et al., 2019).

Furthermore, the use of microblogs can mediate uptake of students' contributions (Omland & Rødnes, 2020), initiate conversations, support collaborative learning and reflection (Gao et al., 2012) and bring in new information (Thoms, 2012). Mercier et al. (2015) showed that Twitter can increase on-task group talk and serve as a tool for teachers to orchestrate classroom dialogues. Examining students' tweets gave teachers insight into group talk and allowed them to pick up on students' misconceptions. Research has shown that tools combining microblogs and digital whiteboards can connect learning activities, such as peer talk and whole-class conversations (Frøytlog & Rasmussen, 2020).

1.5 Moving between different kinds of classroom talk

Both monologic and dialogic talk have their place in a lesson trajectory (Scott et al., 2006). In dialogues, knowledge is co-constructed in collaboration, allowing students to "figure out, not just remember" (Nystrand et al., 1997, p. 17). However, when the teaching purpose is to guide the students towards a predefined answer, an authoritative or monologic approach to teaching may be most productive (Aguiar et al., 2010).

This study aims to investigate how the discursive strategies used in group and whole-class interactions contribute to students' meaning-making and how teachers can exploit the advantages of dialogic and monologic approaches to meaning-making by using technology to transmit meaning across these participation structures. As discussed, previous research has investigated dialogues in groups and whole class. However, as Webb et al. (2019) pointed out, previous research has rarely investigated whether students and teachers participate differently across participation structures, and whether any variation influences students' meaning-making. This article aims to contribute to previous research by investigating differences in discursive strategies used in group and whole class interactions, how these strategies influences students' meaning-making and how teachers may exploit the dialogic potential from group talk in whole class interactions. This study also adds to previous research by investigating how technology can support teachers with tools that can mediate between such participation structures.

The analysis is grounded in the following research questions:

1. What discursive strategies characterise the dialogue in the group and whole-class interactions?

2. How do the particular characteristics of group and whole-class interactions contribute to the students' meaning-making?
3. How can technology facilitate transitions between group and whole-class interactions?

2. Methods

2.1 Project, material and selection

The teacher in the analysed trajectory participated in the research project *Digitalised Dialogues across the Curriculum* (DiDiAC), a collaboration between the University of Oslo, the University of Cambridge and 22 teachers in Norway and England. The aim was to develop teaching practices that combined dialogic teaching (https://thinkingtogether.educ.cam.ac.uk/) with a microblogging tool Talkwall to support classroom talk. Talkwall combine the affordances of microblogging and digital whiteboards. The design principles are discussed in Appendix A.

The empirical material for this article, follows one teacher and her Grade 10 students (aged 14–15) during eight lessons (Trajectory 1) focusing on the period after World War II (WWII) in social science (see Appendix B for an overview of the lessons and Appendix C for details regarding data collection, selection and transcription). Trajectory 1 was watched and categorised according to the subject content of the lessons, use of Talkwall and patterns of interactions like peer talk, individual work, group work and whole-class conversations. The recordings were then viewed again and thematically analysed (Braun & Clarke, 2006, 2012) by watching episode by episode while focusing on the interactions. This process identified patterns deemed significant for the classroom culture: the teacher's moves to make the students talk together to figure out problems, how she built on the students' contributions and how she implemented, encouraged and practiced the ground rules for talk established in the first lesson. Studying the whole trajectory in this way offered insight into how the classroom culture for exploratory talk was cultivated and maintained.

This categorisation work drew attention to how the teacher balanced her lessons between peer talk and whole-class interactions, to a large extent building the whole-class interactions on students' contributions. When using Talkwall, the technology often supported this facilitation. From the second lesson in Trajectory 1, a 14-minute trajectory exemplifying this support (Trajectory 2) was selected for closer analysis. Trajectory 2 was chosen for two main reasons. Firstly, it addressed the aim of investigating how Talkwall was used to mediate between group and whole-class talk. Secondly, the

teacher chose to discuss the contribution from the video-recorded peer interaction in the following whole-class conversation. Thus, this trajectory allowed following the students' development of thoughts and actions across different participation structures.

2.2 Analytical approach

The data was analysed using video-based interaction analysis (Derry et al., 2010; Enqvist-Jensen et al., 2017; Jordan & Henderson, 1995). Meaning-making (Rasmussen & Damşa, 2017; Linell, 1998, 2009) was studied by focusing on interactional details in the selected learning trajectory (Mercer, 2008). This approach allowed for studying the utterances in light of their position in a chain of interaction (Bakhtin, 1986).

Trajectory 2 was watched repeatedly, and both video and transcripts were discussed in groups with co-researchers (see Appendix C for further descriptions). The comparison of transcripts from the interactions in groups and whole-class revealed a general difference. The turns in groups were short with many exchanges between voices, while the turns in whole-class interactions were often long and exchanges much rarer. To investigate the dialogic implications of these differences, the literature was searched for concepts best describing them. This search resulted in the following three analytical concepts:

- *Interruption* (Nikulin, 2010) describes when one interlocutor in the conversation begins to talk while another is talking, thus intercepting the first interlocutor's utterance.
- *Interthinking* (Mercer, 2000) describes how people, through joint intellectual activity, can use language to think together, make sense of experiences and solve problems to achieve more by working together than alone. Interthinking is operationalised as interactions where the interlocutors build on each other's voices to make new meanings.
- *Synthesising* (Wegerif, 2008) involves talk in which multiple meanings emerge. The process is directed towards evaluating or comparing the different views to find consensus or temporal sharing (Rommetveit, 1992).

These concepts describe slightly different levels of interactions. While interruptions describe strategies used within turns, interthinking and synthesising describe meaning-making across voices. The following analysis will investigate the relationship between them further.

3. Analysis

The students in this study attended a 10th grade class in a lower secondary school (ages 14–15) located in one of the largest cities in Norway. The class consisted of 27 students (15 boys and 12 girls). The thematic analysis revealed how the class built and maintained a culture for dialogic interaction. During the first DiDiAC intervention, the class agreed upon a set of ground rules. In the first lesson of Trajectory 1, the class reminded each other of these rules and discussed why they were important tools for talk, as in the following turns:

Ilyas:	Eh:: you don't learn anything by, ( ) when everybody talks at once.
Teacher:	You don't learn anything. And, what are you supposed to learn by the interaction?
Ilyas:	Like, when you talk together you share your own opinions and then you can acquire others' opinions because you think they are better, right.

These turns demonstrate how Ilyas viewed talking together, sharing opinions and changing one's opinion as a result of listening to others as tools for learning. The repeated viewings of the data confirmed that this reflected the students' general view and revealed how the class regularly practiced the ground rules during talk.

In every lesson in Trajectory 1, the teacher asked the students to talk to their peers to solve problems or produce answers. Afterwards, the teacher asked about their thoughts in whole-class, using the students' answers to build new meanings, often through questioning. In this way, the teacher used the students' contributions at the core of the classroom meaning-making. The class had established a culture where problems were solved and new meanings were made through interaction. The following analyses will show how this culture was paramount for the interactions.

The lesson in which Trajectory 2 occurred concerned conflicts. Confirming the above strategy, the class explored the concept in groups, on Talkwall and in whole-class conversations before the teacher presented them with a definition. She then urged the students to discuss the quotation "My liberty ends where yours begin" by John Locke, a philosopher discussed in previous lessons. One interpretation of the quotation is that freedom is a limited resource that can be taken away and that taking large liberties may compromise someone else's, which could be the source of conflicts. The teacher introduced Trajectory 2 by saying, "John Locke said that (…) 'my liberty ends where yours begins'. What did he mean by that? Can you talk a little about that?" The following paragraphs will discuss how the students exploited the open nature of this assignment.

3.1 Generating ideas

The group conversation in the subsequent transcript followed the teacher's instruction. The students immediately started talking productively despite the challenging task, confirming that they had developed a classroom culture where they were used to working this way. The students in the focus group, Inaya, Imen, Rashid and Heidi, collectively tried to grasp the meaning of the quotation by testing out different interpretations.

Transcript 1

Turn	Speaker	Action
1	Inaya	That, in a way, if he finishes, then the conflict (…). Or wait a little ((puts her hands over her eyes)). The liberty goes to the other person, because one part surrenders.
2	Imen	Wha::t?
3	Inaya	Listen! Like that World War II. The Soviet Union. Hitler died. The conflict stopped, and who got the power? (…) The people. [Because they
4	Imen	[Yes, but I think Anna ((the name of the teacher)) meant, like, what does, what does the sentence mean in itself? My liberty ends where yours begins.
5	Inaya	[Yes, that's what I'm trying to
6	Heidi	[Yes, it's like. It's like that thing one door opens, another one shuts, in a way. Just, about liberty [for inst
7	Imen	[Yes ((nods))
8	Heidi	Yes
9	Inaya	Wha:t?
10	Rashid	I surrender [when you surrender
11	Heidi	[That thing when one door shuts, then another door opens. That ( ) thing (…)
12	Inaya	Oh (…) ye::s
13	Heidi	It is in a way the same thing, just about freedom. That if one thing ends, there will always be a new one. Just that for him there is if my thing ends, then begins (…)
14	Rashid	If your thing ends, my thing ends as well.
15	Heidi	Yes, something like that (…) for instance. ((The teacher interrupts the group work, asking the class to make posts on Talkwall.))

Inaya tried to explain the quote (T1) before Imen reacted with a long-drawn "Wha::t?" (T2), indicating that she found Inaya's explanation unclear. This led Inaya to justify her utterance, elaborating by pointing to World War II (T3). Imen interrupted (T4), indicating that she understood Inaya's meaning with a "Yes" before trying to clarify her previous question (T2) and the assignment. This led Inaya and Heidi to answer simultaneously. Inaya seemingly tried to continue her line of reasoning (T5) but

stopped speaking, while Heidi continued her utterance, comparing the quote to a metaphor (T6), thus testing another interpretation. Imen interrupted her, confirming her view (T7), but Inaya signalled that she did not understand, copying Imen's "Wha:t?" (T9). Rashid then entered (T10), but Heidi interrupted him, answering Inaya's "Wha:t?" by elaborating through reminding the others of previously shared knowledge (T11). In the last turns (T12-T15), the students confirmed and elaborated on this interpretation, before the teacher interrupted the conversation, asking the class to post contributions on Talkwall.

By testing out different interpretations (World War II (WWII) (T1), a metaphor (T6) and others (T10, T14)), the students connected the current learning situation to previous knowledge and added richness to their understandings. They coordinated their interpretation of the quote using different strategies. Most apparent was the way they interrupted each other (T4, T6, T7, T11). When Imen interrupted Inaya's reflections about WWII (T4), she apparently felt that Inaya had not understood her. Thus, she tried to help Inaya coordinate with her own thoughts by elaborating on them. Also, when Imen interrupted Heidi with a "Yes" (T7), the interruption served to help coordination by informing Heidi that she understood. Their interruptions reflected their eagerness in trying to understand the quote, introducing new understandings (T6), elaborating utterances (T4, T11) as well as confirming coordination (T7). In these ways, their interruptions became tools for interthinking. Sometimes, coordination was also confirmed by uttering "yes" without interruptions (T12, T15). Heidi's interruption of Rashid (T11) answered Inaya's question for elaboration (T9) and thus, was directed at coordination with her.

Another coordinating strategy was their use of everyday language. The students used "wha:t?"[2] (T2, T7) to indicate that they did not understand and needed an elaboration, thus signalling a lack of coordination inviting repair. The students' uptake of this expression (T3, T13) confirms that it served as a challenge that invited elaborations. Because it led the students to justify their previous utterances and explore the meaning further, it moved the dialogue forward. Their use of "wha:t?" enhanced the exploratory nature of their talk. In contrast to these successful attempts at coordination, Rashid's

[2] In the original language they say «Hæ:?» which is a sound expression and not an actual word, but which is frequently used in the meaning of the English "What?"

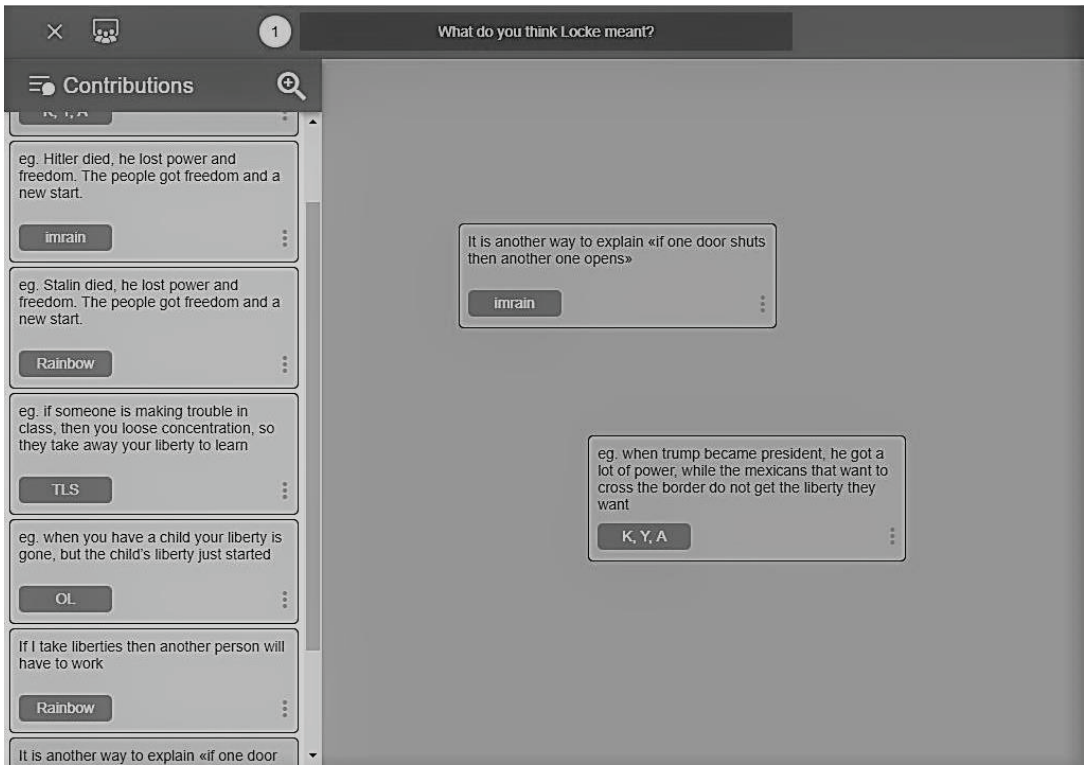
utterances (T10, T14) became cumulative additions to the interactions, seemingly not contributing much to the meaning-making.

This transcript shows how the group was interthinking, with every member contributing to the common goal of understanding the quote. The meaning-making happened in the tension between utterances rather than within a single utterance. This became especially apparent in the sequence of T6 to T11, where the initial contribution (T6) was confirmed (T7) and then questioned (T9) before two different interlocutors (T10, T11) elaborated on it.

The students created a dialogic space that allowed for exploration of interpretations reflecting on previous knowledge. This space maintained open because they did not try to find one correct answer or evaluate the ideas. They allowed for different interpretations, which added richness to their discussion. Their interruptions led to coordination of thoughts and active interthinking, moving towards further understandings without synthesising tendencies favouring one explanation over others.

3.2 Discussing other groups' microblogs

The following transcript begins approximately four-and-a-half minutes after the previous ended. During this interval the group agreed to post two microblogs representing the two main interpretations (Transcript 1), confirming their tendency not to synthesise. The logs from Talkwall show that the focus group wrote "It is another way to explain 'if one door shuts then another one opens" and "e.g. Hitler died, he lost power and freedom. The people got freedom and a new start". Transcript 2 shows how the different Talkwall-contributions from the whole class became the object of the group dialogue.



↑ ↑

Feed – shows all contributions made by the participants.

Wall – display the contributions the creator of the Talkwall has selected from the feed. The creator can move or unpin the contributions.

Fig. 1: Reconstruction of Talkwall. The focus group is anonymised as imrain.

Transcript 2

Turn	Speaker	Action
1	Imen	((Reads aloud)) For instance, when Trump became president, then he got a lot of power, while the Mexicans that crossed the border [do not get the liberty they want.
2	Rashid	[Trump (…) Why is there not a capital t there ( ) ((reading the post commenting on the spelling))
3	Inaya	((looking at the screen)) It is so much different [stuff here!
4	Imen	[That's actually true, because the Mexicans' liberty ended [when Trump became president.
5	Inaya	[Yes, just like with World War II ( ), you see? So what we wrote is not wrong. It's not like specific either (…) ((Their conversation drifts to extracurricular subjects before the teacher gathers attention for a whole-class conversation.))

In the first utterance Imen read another group's Talkwall-contribution aloud from the computer screen (T1). Both Rashid and Inaya were also looking at the screen. Rashid commented on the spelling of another group's post (T2), and Inaya remarked on the multitude of contributions (T3). These utterances were overlapping and not thematically related to each other, giving the impression that the students were thinking aloud in parallel, not regarding each other's utterances. Imen then interrupted Inaya (T4), evaluating the Talkwall-post she initially read aloud (T4). Inaya interrupted her, confirming her evaluation with a "yes" and showing that she also heard Imen's initial utterance. She then interpreted the contribution as support for their own about World War II (T5).

This conversation moved between individual reflections (T1–T3) and dialogue where the students compared contributions (T4–T5). These five turns include three interruptions, but only the last one (T5) served the same coordinating purpose as in Transcript 1. The first two (T2, T4) demonstrated the students reflecting aloud, seemingly without coordination, probed by the same object – the display showing the Talkwall-contributions from the class.

While the students reflected on the other groups' contributions as they reflected on their own group's ideas, as possible interpretations of the quote, they also demonstrated some new tendencies. Imen evaluated the contribution she initially read aloud: "That's actually true, because the Mexicans' liberty ended when Trump became president" (T4). Inaya built on this, interrupted her and compared the contribution to their own about WWII (T5). This comparison strengthened her positive evaluation of their own contribution but seemingly also made her see some weaknesses ("It's not like specific either"). The girls' evaluations show how they started to synthesise the contributions towards finding consensus. The dialogue moved from an exploratory approach (Transcript 1) towards a more evaluative and synthesising one, but they were also interthinking; Inaya built on Imen's comment, using it as support for her own line of thought (T4–T5).

As mentioned, the teacher built on contributions from peer talk in whole-class interactions in every lesson in Trajectory 1. The lesson involving Trajectory 2 was one of three lessons where Talkwall mediated this process. Transcript 2 shows how the technology provided a visualisation of the class's combined effort that allowed the students to compare and contrast contributions from the entire class. Thus, the technology expanded the dialogic space and added richness to their interactions by allowing the students to compare each other's contributions. As shown in the reconstruction (Fig. 1), almost all contributions are examples instead of explanations of the quote. Even though Imen addressed this in

Transcript 1 (T4), the group still ended up posting two examples. Inaya was perhaps also addressing this aspect when she pointed out that their answer was "not like specific" (T5, Transcript 2). The problem of not being able to give explanations may be due to the complexity of the assignment. By promoting possibilities for coordination beyond the group, Talkwall allowed for new explorations, expanding the interthinking towards including the whole class. This moved the students towards a more synthesising approach, expanding from purely exemplifying.

3.3 Microblog as subject for whole-class dialogue

As a starting point for the whole-class conversation, the teacher chose one of the two Talkwall-contributions the focus group posted. The following interaction occurred nearly three minutes after the one in Transcript 2 ended. During this period, the interactions in the focus group drifted to extra-curricular topics before the teacher gathered the class's attention.

Transcript 3

Turn	Speaker	Action
1	Teacher	((Reads a post from Talkwall)) "It is another way to explain if one door shuts, then another one opens". Yes. Who said that?
2	Heidi	That is us.
3	Teacher	What did you think here? When one door shuts, then another one opens. Can you elaborate a bit?
4	Heidi	No. Because. If. It's a way, it's just another way to say that quote with my liberty ends and yours, where yours begin, because if you end a chapter in your life, then it closes. But there will still be another chapter which opens.
5	Teacher	Mhm. So, it, it doesn't set limits for you, but opens [other doors?
6	Heidi	[Opens for other opportunities.
7	Teacher	Ye:s. Mhm. Is it (…) Did you agree on that?
8	Inaya	((Nods))
9	Teacher	What about the rest of us? Listen to it. "It is another way to explain if one door shuts, then another one opens" ((reads from Talkwall)). What do we think about that?

The teacher began this discussion by reading the chosen Talkwall-contribution aloud and locating the group who posted it (T1). Heidi answered (T2), and the teacher asked her about her group's thoughts regarding the post, encouraging her to elaborate (T3). The teacher invited Heidi to represent her group, making her accountable for their contribution. The teacher's open questions invited dialogic participation. Heidi began explaining (T4) before the teacher rephrased her answer, formulating it into a question (T5). Heidi interrupted this question, beginning with the last word the teacher uttered before

the interruption started. Thus, she gave the impression that she was finishing the teacher's interpretation of her own thoughts (T6), showing her to what degree their thoughts were coordinated. In this transcript, these two turns (T5, T6) best demonstrate interthinking. The teacher then gave the impression that she reflected on Heidi's elaboration by saying, "Ye:s. Mhm." (T7), thus acknowledging it. After making all members accountable for the group's post by asking if they agreed with Heidi (T7), the teacher opened for further discussion about the post by asking the rest of the class, "What do we think about that?" (T9).

This interaction shows how the teacher practiced a range of dialogic moves. She initiated the conversation by posing open questions and inviting elaboration (T3). Next, she rephrased the student's answer into a question, probing further elaboration (T5). In the last turn, she acknowledged Heidi's elaboration by raising it to the whole class, thus validating the student's contribution through uptake (T9). Instead of offering her own opinion, she used her students' voices both as a starting point and for elaborations. The thematic analysis of Trajectory 1, as well as previous studies (Omland & Rødnes, 2020; Rødnes et al., 2021), showed that the teacher had incorporated these moves. Through this practice, the teacher modelled relating to others' utterances in dialogic participation.

As explored later, the interpretation in the Talkwall-contribution the teacher chose to discuss differed from her own. Choosing this particular contribution over one more in line with her own interpretation opened a dialogic space facilitating the comparison of voices, thus allowing for a synthesising process between student voices and her own. Importantly, this move also allowed her to discuss her students' misinterpretations. Their justifications gave her an understanding of the reasoning that led to these misinterpretations. The digital tool served as a placeholder for ideas, allowing the teacher to browse, compare, think and select a contribution that could help promote a desired line of reasoning.

3.4 Guiding towards a goal

This transcript continues the whole-class conversation after cutting six turns. During these, Inaya, representing the focus group, tried out two different interpretations of the quote while the teacher was probing her. In the following turns the teacher directed her questioning to the whole class.

Transcript 4

Turn	Speaker	Action
1	Teacher	Why did I pick this sentence now when we are talking about conflicts? Because this is not a sentence that belongs to conflicts. It is actually more about new possibilities. Actually the opposite. Why did I do that? Why did I pick that on the topic of conflicts? Inaya can be first, since you [also arrived at ( )
2	Inaya	[Because, like, when the conflict ends, then there is always something new coming up. That might be a good thing or a bad thing. A good thing because then you agree, and a bad thing because then you disagree and then it continues. And that can be connected to creating an agreement.
3	Teacher	Mhm. (…) Ehh:: At the same time you see this other one ((pointing to Talkwall)) (…) If not Aisha ((raising her hand)), you wanted to say something?
4	Aisha	Ehh. A conflict can be a war, and like, when there is war you wish for liberty, and all liberty is not, like, the same thing. It's like, my liberty is not the same as another person's liberty.
5	Teacher	No? My liberty is not the same as another person's liberty. Omar? ((raising his hand))
6	Omar	That sentence can be associated with conflict, because, for instance Palestine and Israel, where Israel in a way wants to rule Palestine. There the liberty of Israel begins, and the liberty of Palestine ends.
7	Teacher	Mhm. Right. Often in wars someone is taking liberties, and other's liberty ends. It is very nice that you interpreted this positively ((looks at the focus group)), by all means. I think he meant it a little more (…) ehh:: the other side, I nearly said. More like (…) that we should be awake, and not let anyone take away our freedom. Right? Do we get that? That if you are taking a lot of liberties, then my liberty ends.

Probing the class towards new ways of thinking, the teacher asked why she may have picked the quote in relation to conflicts (T1). Inaya answered by defending her group's reasoning, bringing in conflict to answer the teacher's probe (T2). The teacher's response to this was "Mhm" before she pointed towards another contribution on Talkwall (T3), seemingly looking for new ways to probe the class. However, she saw Aisha's raised hand and heard her comment instead (T3). Aisha stated that liberty is not the same for two persons (T4). The teacher confirmed her negative with a "no" and a repetition of her utterance before she let Omar, who was also raising his hand, comment (T5). He exemplified the quote with the Israel–Palestine conflict (T6). Seemingly agreeing, the teacher evaluated this with "Mhm. Right" before she presented her own interpretation building on his (T7).

In this transcript, the teacher's synthesising work became the most prominent tool. Even though she practiced several dialogic moves, she used these moves to guide the students towards the interpretation she wished for, synthesising their voices towards shared understandings. She evaluated the students'

contributions on two levels. The first illustrates her dialogic stance. By uttering "mhm" (T3) and doing uptake of their contributions (T5), she evaluated them as valid and interesting for the whole-class conversations. In this way, she encouraged participation, and the students felt safe enough to try out new lines of reasoning in whole class (T2), indicating that she succeeded. On the second level she evaluated their contributions in relation to the interpretation she judged as right, thus showing her synthesising work. She did this indirectly by probing the students' thoughts when she disagreed with them (T1). Also, when Inaya tried out thoughts that did not lead where the teacher wished for (T2), the teacher stopped her by asking guiding questions or by changing the topic (T1, T3). Furthermore, she evaluated the students' contributions directly by confirming their interpretation when she judged them to be in line with the right one (T5, T7). Finally, she presented her own understanding of the quote (T7). Using these strategies, the teacher synthesized the discussion by concluding the class's interpretation. In this last transcript, the teacher managed to preserve a dialogic approach by building on the students' voices while driving the discussion towards valid knowledge. In this way, she helped the students' understanding expand beyond examples by lifting the interpretation towards an explanation. Through these guiding strategies, she synthesised the discussion towards the wished-for interpretation, thus concluding the trajectory.

The whole-class interactions (Transcripts 3 and 4) occurred between the teacher and a sequence of students rather than among the students themselves. Even though the teacher managed to preserve a dialogic approach, the coordination was mainly between the teacher and individual students representing their groups. The teacher distributed the participation, and the utterances were initiated by the teacher rather than spontaneously building on each other. The teacher did not interrupt the students, allowing for longer lines of individual reasoning. As a result, many of the utterances resemble short monologues, and this approach gave the students fewer opportunities for modifications.

Still, these interactions also show interthinking. Inaya used the teacher's probes in her reasoning (T1), and Aisha's (T4) and Omar's (T6) utterances also showed uptake of this probing, in addition to bringing in elements of their previous reflections. The students' voices also influenced the teacher's reasoning. She let Aisha interrupt her when engaging with a new Talkwall-contribution (T3), allowing her participation to define the evolvement of the conversation. She also built on Aisha's and Omar's contributions (T4, T6) when she reached her conclusion (T7). Despite these elements of interthinking, the teacher guided the interaction. Thus, in the whole-class interaction, the interlocutors made meaning

individually or through guided interthinking, not collaboratively with peers. Building on this meaning-making, the teacher synthesised the discussion, reaching valid knowledge in this subject context.

4. Discussion

4.1 Dialogue in groups

The above analysis confirms the important role group dialogues can have in a learning trajectory by showing what the students achieved using interruptions and utterances like "wha:t?". These moves promoted productive dialogic participation by inviting elaborations and mediating coordination, thus enhancing explorations. Using these discursive moves, the students made meaning dialogically through interthinking, connecting new understandings to previous knowledge and deepening their learning (Barton et al., 2008; Moje et al., 2004). Their meaning-making depended on the tension supplied by their interlocutors' responses and took place between interdependent voices (Bakhtin, 1986; Wegerif, 2008).

The teacher used different strategies to facilitate productive peer dialogues. The class had made their own ground rules and had established a classroom culture for talking this way. Importantly, the teacher introduced the trajectory with an open assignment that gave students authority in exploring it (Engle & Conant, 2002). In the group dialogues, the students exploited this authority by exploring the quote in copious interaction with several interpretations. The open assignment provided space for exploratory interthinking, thus promoting rich discussion instead of focusing on the production of a correct answer (Furberg & Ludvigsen, 2008).

4.2 Whole-class dialogue

The teacher facilitated the whole-class interaction by practising varied strategies. By picking up on their Talkwall-contributions, she made the students accountable for the group talk (Engle & Conant, 2002). She also asked open questions and validated ideas by uptake of them (Nystrand et al., 1997) as well as inviting elaborations and rephrasing students' answers (Michaels & O'Connor, 2015). Using these strategies, the teacher built the conversation on her students' utterances, thus creating space for their voices in the whole-class talk. As seen in Transcript 4, the students' voices were decisive for the development of the conversation. Thus, these conversations showed interthinking. By practicing a

dialogic stance in these ways (Boyd & Markarian, 2011), the teacher made the discourse more balanced, and her voice became one voice amongst many (Nystrand et al., 1997).

Even though the interaction had these dialogic elements and comprised interthinking, the teacher's voice guided the students towards synthesising a shared way of talking about the subject. She clearly had a goal for where she wished the interaction to end, and parts of the meaning-making happened within utterances. In her synthesising work, her voice was positioned above the others in the search for consensus. These kinds of interaction, comprising both meaning-making across voices and one voice guiding others, are characterised as *guided interthinking* in this article.

4.3 Meaning-making across participation structures

In the group dialogue, the interthinking was characterised by exploration of different voices grounded in the students' everyday knowledge. In the whole-class dialogue, the teacher guided the interthinking. These findings emphasise the dialogic differences constituted by differences in participation structures. Both these kinds of dialogue are needed in classroom meaning-making. While the students explored previous knowledge during group talk, creating a foundation for further understanding, the teacher's guidance during whole-class discussion was necessary for the synthesising process that concluded the trajectory. This kind of guiding, where the teacher builds on the students' everyday knowledge, is necessary for leading students towards appropriating relevant school knowledge (Boyd & Markarian, 2011).

The findings suggest that, at least in classrooms, monologue and dialogue are not a dichotomy. The interactions in whole-class talk had both dialogic and monologic qualities, and the interactions in groups (Transcript 1) had both exploratory and cumulative aspects. In the analysed trajectory, the teacher used both dialogic and monologic strategies, depending on the aim of her action. She built the interactions from her students' voices while keeping her aim of reaching subject-relevant knowledge. In this hybrid dialogue, she used guided interthinking as her most prominent tool.

By combining the different participation structures in one trajectory, the teacher ensured that her students engaged in interthinking and explored everyday knowledge. They built on the experiences from the group talk and related them to subject-specific understandings in the whole class interaction, thereby partaking in the synthesising process leading towards knowledge that is seen as valid in a school context.

4.4 Technology-mediated dialogue

Given the benefits of combining dialogues in groups with whole-class dialogues, teachers need tools to support this approach. Previous research investigating how technology can be used to facilitate classroom dialogues has often focused on interactive whiteboards mediating whole-class conversations (Gillen et al., 2007, Mercer et al., 2010) or microblogging as a tool for peer interactions (Gao et al., 2012; Mercier et al., 2015). Because the DiDiAC-project—that this study is a part of—combines these technologies, the analysed approach gave access to study the teacher's uptake of peer talk in whole-class interaction. Talkwall facilitated the transition of ideas, thus expanding the group talk into whole-class conversation. Because the product of the group conversations was a contribution that became visible for the whole class and the teacher, Talkwall facilitated the students' accountability for their talk (Rasmussen & Hagen, 2015). The teacher's use of the contributions as building blocks for the whole-class discussion enhanced this accountability, which is crucial for making the group talk productive (Engle & Conant, 2002).

Talkwall provided a visual representation of the class's combined effort and allowed the students to explore and compare ideas from the rest of the class to their own. In doing so, Talkwall expanded the group dialogue to comprise contributions from the rest of the class, which expanded the interthinking and facilitated the beginning of the synthesising process. The technology served as a visualisation that both opened a dialogic space for sharing ideas (Mercer et al., 2019) and supported the process of novel combinations of them (Martin & Schwartz, 2014).

By displaying the main points from the group conversation, Talkwall gave the teacher time to compare and reflect before choosing to follow up on contributions that seemed relevant for further reasoning. By asking the students about the reasoning behind their contributions, the teacher acknowledged their interthinking during peer talk. The abridged format of the Talkwall-posts promoted this kind of elaboration. Furthermore, by choosing a contribution not in line with her own thoughts, the teacher created a dialogic space for further exploration of the students' contributions and thus acknowledged the importance of their reasoning. Furberg and Ludvigsen (2008) pointed out that a challenge with peer talk can be that only the product is picked up in whole-class discussion, thus making productive peer talk less important than getting the answer right. The analysed use of Talkwall ensured that elements of the peer talk were discussed during whole-class interaction.

5. Conclusion

The analyses have shown how interruptions, interthinking and synthesising can constitute central discursive strategies in classroom meaning-making. Because these strategies are unequally distributed in group and whole-class interaction, a combination of participation structures seems particularly productive. The use of technology was found productive in mediating the transition of students' contributions between these structures by enabling all participants to read and choose between all contributions. By mediating comparison between students' contributions, Talkwall initiated the synthesising process, which was concluded in whole-class interaction.

Mutual understanding is necessary for students to be able collectively to develop new lines of thoughts, making coordination a condition for both interthinking and synthesising. In the group interactions depicted in this article, interruption was particularly productive in achieving coordination of thoughts and in exploration of multiple views. As these views were the foundation for the synthesising during whole-class talk, the group dialogues became an indispensable part of the process of dialogic meaning-making.

Functioning as a tool for coordination, interruptions also supported the interthinking process. As seen, the whole-class conversation featured interthinking almost without interruptions. Here, the teacher guided the interthinking, and she often used other coordinating strategies, such as probes and uptake. The differences between the interthinking taking place during group talk and during whole-class conversation were related to how meanings were explored. During group talk, meanings were explored without evaluations, whereas the guided interthinking during whole-class conversation was directed towards valid knowledge.

In the whole-class interaction, interthinking became a tool for synthesising. Because synthesising is directed towards evaluating or comparing different views to find consensus or a shared view, the coordination of these different views is necessary for productive synthesising to emerge. Students initiated this coordination during the group talk, and the teacher facilitated it further by using specific questions and cues to guide the whole-class interaction. Synthesising is paramount for reaching knowledge that can be shared and validated. By describing the discursive strategies used by the students and the teacher in exploring a subject topic, the analyses showed how such synthesising could be achieved.

This study has shown how a teacher facilitated and combined productive dialogic explorations in groups with guided interthinking in whole-class interactions. Through the analysed strategies, she exploited the advantages of classroom dialogue and reached valid knowledge.

Hopefully, this article can contribute to future lines of research on how to facilitate classroom interactions that lead to productive meaning-making. In particular, more studies on how different types of technologies can mediate classroom interactions are needed to describe a larger variation of strategies.

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Appendix A: Talkwall – design principles

Talkwall combines the affordances of microblogging tools and digital whiteboards. For each assignment, the teacher makes a heading, often a posed question. The participants can then post short contributions (microblogs) as answers to the teacher's question or assignment. All contributions are visible for the participants in a feed, and the students or the teacher can choose to add the microblogs to a wall. The wall allows for different ways of sorting the contributions. Each participant can create an individual wall, and the teacher can choose from all the participants' walls and display any of these on a classroom screen, such as a digital whiteboard. Fig. 1 (section 3.2) shows the functions of Talkwall. The Talkwall -design allows for different opportunities. An overview of the ones used in the analysed lesson, is listed below:

1) The teacher creates a *heading* often in the form of a question, to the Talkwall -assignment.
2) Participants can then post *contributions* that consist of microblogs. These are limited to 140 characters in order to keep focus on the oral dialogue, not to substitute it.
3) The posted contributions become visible to all participants in a *feed*. Through this feed, all students' contributions are shared among the participants, allowing for mutual awareness of each other's ideas.
4) Participants can select contributions and pin them to a *wall*. On the wall, the participants can sort the selected contributions in various ways.

5) The teacher has access to all participants' walls, and can present a wall of choice (including one's own) on a shared digital whiteboard.

Appendix B: The lessons in Trajectory 1

Lesson number	Minutes	Discussed subject	Talkwall use
1	45 min	They discuss ground rules and why they are needed.	No
2	90 min	They discuss conflicts, explore the concept and come up with different examples of conflicts. TRAJECTORY 2 IS SELECTED FROM THIS LESSON.	Yes
3	45 min	They repeat what a conflict is and start learning about the Cold War.	No
4	90 min	They discuss the consequences of WWII and the differences between communism and capitalism, and start talking about how Europe changed after the war.	No
5	45 min	They repeat the subjects from the previous lesson, and the students help each other to remember in different groups.	No
6	45 min	They discuss their attitudes towards communism.	Yes
7	90 min	They continue the discussion from the previous lesson and extend it to include capitalism and freedom of speech.	Yes
8	90 min	They discuss different topics related to the Cold War, including how Europe was divided, the arms race, NATO and the Warsaw Pact, espionage and the EU.	No

Appendix C: Selection, data collection and transcription conventions

The main data collection in the DiDiAC project, involved the study of single lessons where Talkwall was integrated as a central tool in the teaching design. This led to curiosity about how the tool could be integrated into a longer teaching–learning trajectory. To investigate this, one teacher and her Grade 10 students (aged 14–15) were followed during eight lessons (Trajectory 1) focusing on the period after World War II (WWII) in social science. The teacher was chosen because previous studies (Omland & Rødnes, 2020; Rødnes et al., 2020) showed that she practiced a range of dialogic strategies and used technology in productive ways. These studies also confirmed that she and her class, which were the same in both data collections, had developed a classroom culture for exploratory talk.

When conducting interaction analysis, group work is essential for revealing individual researchers' biases, and for validation of interpretations (Jordan & Henderson, 1995). Being a single author may thus seem in conflict with this analytical approach. However, the analytical work done in this article reflects group efforts. In the DiDiAC-project, we regularly discussed excerpts, and the empirical material in this article has also been repeatedly discussed in other forums, such as research groups at the University of Oslo and in a Nordic research network on digitalising childhoods.

The lessons were video-recorded with one camera and two microphones. The camera and one of the microphones alternated between one focus group and the whole class. One microphone recorded the teacher. The empirical material also consists of field notes and logs from Talkwall. The recorded lessons were transcribed using the conventions below. Participants' names were anonymised.

Transcription conventions:

Sign	**Explanation**
(…)	This sign indicates a short time interval between speech.
[	A square bracket indicates the onset of an interruption or overlapped speech.
:::	Colons indicate the lengthening of a word or sound.
( )	Empty parentheses indicate that it was difficult to hear what was said.
((looks up))	A sentence that appears within double parentheses describes an action.

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