Microblogging and classroom talk

Teachers' practices and students' participation in talk for learning during microblogging activities in the classroom

Anja Skrepstad Amundrud

Thesis submitted for the degree of Ph.D.

Department of Education, Faculty of Educational Sciences
University of Oslo

March 2022

Acknowledgements

This thesis is a product of collaboration, and many people deserve to be thanked.

I want to thank all the teachers and students participating in the DiDiAC project for being the most important research partners! A special thanks to teacher H at Central Primary, your engagement in this project has been essential.

This thesis would of course not have been possible to write without my two supervisors, Ingvill Rasmussen and Ole Smørdal. The two of you have given me excellent support during the whole Ph.D. process. Your comments on drafts and co-writing of the articles have been fundamental for their progress and quality. Ingvill, you are an academic role model and I have learned so much from you. I know that the work and effort that you have put into leading me along the way of the writing of this thesis is far beyond what's in the work description for a supervisor. I am forever thankful and I look forward to collaborating more with you in the future. Ole, you have followed my work since I was a master's student, you recommended I apply for the Ph.D. position, with your connections in Toronto I was allowed to visit two leading research groups at the U of T and you have even made sure that I can continue the work with exciting projects when the thesis is finished. Your input on my work, positivity and support has been and still is extremely helpful. Thank you!

I am very thankful for participating in the DiDiAC project group. A special thanks to Sten Ludvigsen, Kari Anne Rødnes and Jan Dolonen for reading many versions of my drafts and providing me with important feedback. And thank you Paul Warwick for the excellent collaborative writing of two of the articles. Thanks to Victoria Cook and Louis Major for their important contributions to the DiDiAC project. Luckily, we were three Ph.D. students in the DiDiAC project. Jo Inge Frøytlog, thank you so much for being both a serious and professional Ph.D. student with a lot of knowledge to share and a good friend. I agree with you that dialogue is very important. Another good friend in the DiDiAC team is Maren Omland. It has been inspiring to see your true engagement in educational research, and I am very grateful for all our conversations about work and other important things like climbing and puzzles. Thank you to Neil Mercer who was part of the extended DiDiAC family and contributed with his knowledge and expertise serving as part of an excellent advisory board and providing me with important feedback on one of the articles. Another DiDiAC family member that deserves to be thanked is Andreas Lund. Your thorough reading, true interest in my work and comments along the way have been both extremely helpful and very motivating for making further advancement.

EngageLab at the University of Oslo has a crucial role in the development of Talkwall. Thank you so much Richard Nesnass, Sharanya Manivasagam, Terje Thoresen and all the other former EngageLab people. The effort that you do by listening to the demands of researchers and getting the technology we want to work in the way that we want it to, is extremely important.

As a member of the research group Living and Learning in the Digital Age (Lida) I have had a lot of support from fellow Ph.D. students and all the senior researchers. Lida members have supported me with valuable opportunities to share texts in all stages and offered important feedback. Also, I have been given insight into all of the Lida researchers' excellent work through discussions of drafts, new articles, theories and methods, which I have learned a lot from.

Being a Ph.D. student in Lida means that I have been part of the self-organised Ph.D.-First Aid group. We have shared texts and given each other useful feedback in a safe environment. Thanks to all of you, Victoria de Leon Born, Rogers Kaliisa, Gro Skåland, Kenneth Pettersen, Kristina Torine Litherland, Emily Oswald, Neha Singh and Morgane Domanchin.

I am grateful to all the researchers and Ph.D. students in the research groups Institute for Knowledge Innovation & Technology (IKIT) and Encore Lab at Ontario Institute for Studies in Education. A special thanks to Marlene Scardamalia and Jim Slotta who welcomed me into your

Sammendrag

Språket er vårt viktigste verktøy for læring, og derfor er det viktig at elever i grunnskolen får undervisning om hvordan de kan snakke sammen på måter som faktisk hjelper dem å lære. Spesielt er dette viktig i klasserom som blir stadig mer digitaliserte.

Eksplisitt undervisning av samtaleferdigheter har i forskningen vist seg å kunne gi målbare resultater i forhold til elevenes læring, også når det gjelder elevenes evne til å tenke kritisk og løse problemer sammen. Men i dagens klasserom er det lite eksplisitt samtaleundervisning, og den økende bruken av teknologi viser en tendens til at det blir mer individualiserte aktiviteter i klasserommet, som igjen kan gi mindre fokus på gode klasseromssamtaler. Med økende bruk av digital teknologi trenger elever å lære seg hvordan man kan snakke sammen på gode måter både muntlig, og i delvis skriftlige former som for eksempel gjennom korte tekster med et *muntlig preg,* slik det ofte kan være i sosiale medier. Denne avhandlingen handler om nettopp samtaleferdigheter og digital teknologi. Studien er en del av det større forskningsprosjektet Digitale Dialoger (DiDiAC), og tar sikte på å utvikle lærerpraksiser som kombinerer samtaleundervisning og mikrobloggingsverktøyet Samtavla for å adressere behovet for utvikling av elevers samtaleferdigheter i digitale klasserom. Samtavla er et verktøy utviklet av forskere og lærere. I Samtavla kan elever skrive korte meldinger, kalt mikroblogger, som ordnes og vises på tavla. De skriftlige meldingene kan støtte de muntlige samtalene, og dermed tilrettelegge for gode læringssamtaler der elever deler, vurderer og utvikler forståelse sammen.

I avhandlingen undersøker jeg hvordan bruk av Samtavla i klasserommet kan være et nyttig verktøy for både elever og lærere i utviklingen av samtaleferdigheter som er viktige i læringssammenheng. Et spesielt fokus rettes mot hva slags strategier lærere bruker for å støtte elevers utvikling av, og deltakelse i læringssamtaler. Det empiriske materialet består i hovedsak av videoobservasjoner av tjue lærere og deres elever på 7. og 8. trinn. Videoobservasjonene er gjort i fjorten norske og seks britiske klasserom gjennom ett semester. De to overordnede problemstillingene som diskuteres i avhandlingen er (1) Hva karakteriserer læreres praksiser når de tar i bruk både eksplisitt undervisning om deltakelse i læringssamtaler og bruker mikroblogging? og (2) På hvilke måter kan mikroblogging i klasserommet legge til rette for elevers deltakelse i læringssamtaler? I kappen diskuteres disse problemstillingene med utgangspunkt i funn fra tre studier som utgjør det empiriske grunnlaget for avhandlingen.

Den første artikkelen bruker tematisk analyse for å beskrive hva som karakteriserer de ulike lærernes strategier for undervisning av samtaleferdigheter ved bruk av Samtavla, og hvilke variasjoner som eksisterer blant de deltakende lærerne. Artikkelen peker blant annet på

at det er stor variasjon blant lærernes praksiser. I artikkelen diskuteres også hvordan Samtavla både trenger støtte fra den eksplisitte undervisningen av samtaleferdigheter, samt at Samtavla kan støtte lærere i undervisningen.

I den andre artikkelen analyseres en utvalgt lærers undervisning av samtaleferdigheter og i artikkelen vises helt konkrete eksempler på hvordan denne læreren arbeider systematisk med å fremme elevenes samtaleferdigheter ved bruk av Samtavla. Artkkelen kommer også inn på hvordan elevene plukker opp samtalepraksisene i sine gruppesamtaler.

Den tredje artikkelen viser hvordan en lærer gjennom sitt undervisningsdesign bruker Samtavla for å legge til rette for læringsaktiviteter som gjør at elevene i gruppesamtaler systematisk får tilgang til flere av sine medelevers ideer. På den måten blir gruppediskusjonene preget av et større mangfold av ideer og elevenes samtaler blir mer utforskende.

Til sammen bidrar de tre artiklene og kappen med mer kunnskap om hvordan lærere og elever kan delta i læringssamtaler ved å ta i bruk digital teknologi.

Avhandlingen er skrevet innenfor kunnskapsområdet pedagogikk og arbeidet har blitt utført som en del av forskningsprosjektet DiDiAC ved Institutt for pedagogikk ved Universitetet i Oslo.

Summary

Language is our most important tool for learning, and therefore it is important that students in primary and secondary education are taught how they can talk together to learn. This is especially important in classrooms where the use of digital technology is increasing. Research has demonstrated that the explicit teaching of talk for learning can promote students learning and their capacity to think critically and solve problems together. However, in today's classrooms, there is only sparse explicit teaching of talk for learning, and the increased use of digital technology shows a tendency to more individualised activities in the classroom, which in turn leaves less time to focus on developing students' talk skills. With more technology in the classroom, students must also be taught how they can talk together to learn both orally, but also in a semi oral manner, such as through short texts in social media that have an *oral character*. This thesis discusses the above issues. The study is part of the larger research project called Digital dialogues Across the Curriculum (DiDiAC) which aim is to develop teaching practices that combine the teaching of talk for learning with the microblogging tool Talkwall to address the need for developing oral skills in digital classrooms. Talkwall is a technology that

has been developed by researchers and teachers. In Talkwall, students can write short messages called microblogs that can be displayed and arranged on a digital whiteboard. The written microblogs can support the students' talk, and thus help students talk together in ways that they learn from.

The thesis explores how Talkwall can be a useful tool in the classroom for both teachers and students to develop students' talk for learning. I particularly focus on the teachers' strategies used to support students' development and participation in talk for learning. The empirical data mainly consists of video observations of twenty teachers and their students in lower secondary education. The data collection is conducted in fourteen Norwegian classrooms and six British classrooms throughout one semester. The two overall research questions that are discussed in this thesis are (1) What characterises teachers' emerging educational practices when combining an explicit focus on talk for learning and co-located microblogging? (2) In what ways can co-located microblogging enhance students' participation in talk for learning? In the first part, the extended abstract, I discuss the findings from three empirical studies reported in research article which are included in part 2 of this thesis.

The first article uses thematic analysis to describe what characterises the strategies the different teachers use in their teaching of talk for learning during Talkwall activities, and the variations that exist between the teachers. The article considers the large variation between the teachers. Moreover, the article discusses how Talkwall both needs support from explicit teaching of talk skills, and that Talkwall can provide support in the teaching of talk for learning.

The second article analyses the details of how one teacher attempted to engage students with the purposes and practices of talk for learning during Talkwall activities. As part of the analysis, the article examines the students' uptake of the practices appropriate to talk for learning in peer group interactions during co-located microblogging activities.

The third article demonstrates how one teacher's educational design uses Talkwall to facilitate learning activities that promote students to systematically engage in each other's ideas during group discussions. Through the teacher's educational design, the students' group discussions are characterised by exploring a range of diverse ideas. Thus, making the student discussions more exploratory.

Together, the three articles and the extended abstract contributes more knowledge to the literature about how teachers and students can engage in talk for learning by utilising digital technology.

The thesis is written within the field of education and the work with the thesis has been conducted at the Department of Education, at the University of Oslo.

Contents

PART II: THE ARTICLES

Article 1

How teachers make talk rules relevant as collective scaffolds in the context of digital technology - support for and from microblogging
(Amundrud, Rasmussen & Warwick)

Article 2

Amundrud, A., Rasmussen, I., & Warwick, P. (2022). Teaching talk for learning during co-located microblogging activities. *Learning, Culture and Social Interaction*, *34*, 100618. https://doi.org/10.1016/j.lcsi.2022.100618

Article 3

Amundrud, A., Smørdal, O., & Rasmussen, I. (2021). # Fact or #opinion: the educational design of a microblogging activity intended to engage students in productive interactions. *Technology, Pedagogy and Education*, *31*(2), 199-215. https://doi.org/10.1080/1475939X.2021.1991997

PART I: EXTENDED ABSTRACT

1 Introduction

If someone asks me what my thesis addresses, my short and simple answer is usually that it is about how we can use technology to encourage more students to participate in classroom talk. One answer I often receive is, "Oh, that would have been nice to have had when I was in school because I found it difficult to talk in the classroom". I believe this sentiment to be true for many students. When I worked as a primary school teacher, I found it challenging to encourage all the students to participate in whole-class conversations. When students were engaged in small-group talk, it was impossible for me to know if everyone participated. Even if all the students participated, I found it difficult to ensure that they were focused on the topic, to ascertain if they understood the topic, and mostly if these peer talks enabled the students to learn something.

What can technology contribute when it comes to encouraging students to participate in classroom talk? This was one of the questions that prompted me to apply for a position in the international research project Digital Dialogues Across the Curriculum (DiDiAC). The research interest within this project focused on the interaction between classroom talk and digital technology, specifically microblogging technology. The ideas behind the DiDiAC project are based on previous research about classroom talk and the importance of developing students' talk skills, and also on policy documents and curriculum goals. Since most classrooms nowadays use some form of technology, an important concern for teachers and researchers is to explore how digital technology can enhance and promote new forms of classroom talk. However, just bringing digital technology into the classroom will not make new forms of talk happen, enabling students to participate more. Digital technology comes with new challenges. It changes things, and not always for the better. For instance, technology can become disruptive when students spend time on activities such as social media, and it can take time to set up computers and computer activities (Blikstad-Balas, 2020; Sahlström et al., 2019). Furthermore, if all students have their own digital device, it is a risk that more individualised teaching will occur (Klette et al., 2018), which will not likely promote participation in classroom talk.

This thesis will not try to provide a complete solution to these challenges. However, as I say to those who are interested in the slightly longer answer to what this thesis is about: The aim is to explore how digital technology can be used to support the development of teachers' classroom practices, specifically teachers' practices that facilitate and support students' engagement in talk that is productive for learning. Hence, the thesis contributes more

knowledge to the literature about how teachers and students in secondary schools can engage in talk that is beneficial for learning by utilising digital technology.

The research within the field of classroom talk and digital technology is growing fast. In the following chapter, I will put forward a few arguments, based on recent research findings, for why we need additional research on these topics. Specifically, I will argue why it is important to pay attention to microblogging and the teacher's role in promoting talk for learning. I will start with previous research on classroom talk.

1.1 Research on classroom talk and digital technology

For decades, researchers have been interested in classroom talk, producing a mounting number of studies that focus on classroom talk, approaches to ensure more productive classroom talk and to develop programmes for oracy development (e.g. Alexander, 2008; Clark et al., 2003; Mehan, 1979; Mercer et al., 1999; Michaels et al., 2016). In the review in Chapter 3, I will present some of these studies. In the following, I will briefly summarise some important findings that support the relevance of this thesis.

Research on classroom talk has found that it essential to students' learning that students engage in and understand the educational value of talk in classrooms (Howe et al., 2019; Howe & Abedin, 2013; Muhonen et al., 2018). It is often taken for granted that students know how to use talk to learn. But, in fact, the capacity to use language as a tool for learning efficiently is not developed through everyday conversations (Mercer, 2002). For the last three decades, researchers have been interested in how to promote more productive types of classroom talk (Mercer & Dawes, 2014). This research emphasises the importance of explicitly teaching students how they can efficiently engage in talk as a means for learning, recommending that students are taught specific ways of expressing their ideas, thinking collectively, co-constructing knowledge and understanding and solving problems together in the classroom (Alexander, 2020; Clark et al., 2003; Mercer & Littleton, 2007; Michaels et al., 2016; Park et al., 2017). This recommendation stems from findings showing that students who are taught how to engage in talk for learning perform better in terms of critical thinking, collaborative problem-solving and reading comprehension (Howe & Abedin, 2013; Kuhn, 2015; Lawrence & Snow, 2011). Explicitly teaching students how to engage in talk for learning can also enhance students' subject performance. In recent years, there has been evidence of subject learning gains in math, English and science, resulting from a focus on talk as a tool for learning (Baines et al., 2007; Jay et al., 2017; Mercer et al., 2003; Muhonen et al., 2018; Rojas-Drummond & Zapata, 2004). Yet, despite these convincing research findings, there is a limited focus in classrooms on

teaching students explicitly how to engage in talk for learning (Gilje et al., 2016; Howe et al., 2019; Park et al., 2017). Moreover, we also know from research that teachers struggle with establishing the type of classroom ethos that encourages talk for learning due to various issues, such as lack of experience, resources at hand and time constraints (Hennessy & Davies, 2019; Mercer et al., 2019; Muhonen et al., 2018; Park et al., 2017). In this thesis, I refer to the classroom ethos as the nature or setting of the classroom. When promoting talk for learning, it is important to develop a classroom ethos where students are encouraged and supported as they take part in conversations in which they can think and construct new knowledge together (Mercer & Littleton, 2007; Wells, 2009).

This research leaves little doubt. It is important to focus on classroom talk. How can digital technologies be used to meet some of the challenges of teaching talk for learning? Before I answer this question, it is crucial to recognise that even though digital technologies provide a range of tools for learning, they also change the existing classroom ethos by adding more complexity and creating new challenges. Digital technologies, such as iPads, computer laptops, projectors and/or interactive whiteboards (IWB), are now present in most classrooms in Norway. At the same time, studies report that individual student work dominates lessons in secondary schools that provide their students with one-to-one digital units (Gilje et al., 2020). This is in line with other studies, which find that students' use of technology in the classroom is often devoted to individual work (Blikstad-Balas & Klette, 2020; Gilje et al., 2020; Sahlström et al., 2019). These research findings may indicate that less time is spent on whole-class talk and group talk in technology-rich classrooms. Another challenge is that students attending school usually have a lot of experience with using digital technologies. Yet, they lack knowledge about how to use these tools for learning purposes. Hence, the ways in which students are used to interact or talk to each other by using digital technology (e.g. via social media sites, messaging and chats) is likely to differ from the type of talk for learning that is expected in the classroom (Lantz-Andersson, 2016; Sahlström et al., 2019; Staarman, 2009). Furthermore, teachers might lack experience with the types of pedagogy that can make use of and build upon students' previous knowledge about digital technologies (Blikstad-Balas & Klette, 2020; Erstad et al., 2021; Gilje et al., 2020; Lund & Rasmussen, 2008).

Still, the presence of digital technologies also undoubtably creates new possibilities for classroom interactions. Important, of course, is the fact that pedagogy, rather than technology, is paramount (Mercer et al., 2019). When used in line with the appropriate pedagogy, digital technologies can function as powerful tools that can potentially support, encourage and promote classroom talk for learning (Major et al., 2018). Thus, for digital technology to promote the

kind of talk that students learn from, students need to be taught explicitly how to engage in talk for learning, both with and without the presence of digital technology. Therefore, because the use of digital technologies in classrooms continues to increase, teachers who promote talk for learning should explicitly focus on the ways in which students can also engage in talk for learning when using digital technology.

While there is research on how students can talk together to learn and how teachers can promote this type of talk, many of these studies have not been conducted in today's technology-rich classrooms with, for instance, individual iPads. There also remains a lack of research on how teachers can design for the explicit teaching of, and students' participation in, talk for learning by using communication technology, such as social media tools, or in classrooms where all students have individual digital devices. Also, few studies have focused on teachers' strategies for teaching students how to talk together to learn when using digital technology designed for this purpose. Scarcely any studies have focused on how the combination of digital communication technology and teachers' explicit focus on talk for learning can create situations where students are systematically encouraged to use digital technology to share their ideas in joint class discussions to promote talk for learning. Similar research on peer collaboration with digital technology when teachers are explicitly teaching students how to collaborate indicates positive results (e.g. Fischer et al., 2013; Kollar et al., 2007). For example, Kollar et al. (2007) investigated how explicit scripts for student collaboration in computer-supported collaborative learning (CSCL) environments guided the student discussions during a science activity and thereby scaffolded their collaboration process. However, these studies do not focus on the teacher's strategies for explicitly teaching talk for learning, and few studies focus specifically on how digital technology can support teachers in this work. There is also sparse research about how teachers can take advantage of digital technology to support students' talk for learning both in group and whole class situations and during transitions between these situations.

Given the above research, I argue that there is a need for more knowledge about teachers' practices with digital technologies and how teachers can systematically use digital technologies in the classroom in combination with an explicit focus on talk for learning. Furthermore, I believe that we need more knowledge about how teachers can design for and develop the type of classroom ethos that encourages student participation in activities where technology is used to support talk for learning.

This thesis will contribute to the research on classroom talk and digital technology. The thesis has been conducted as part of the larger design-based research project DiDiAC. Therefore, I have collected data from an intervention using one specific technology, namely

4

microblogging (Major et al., 2018), that can potentially support classroom talk within the framework of the pedagogical approach 'Thinking Together' (Mercer et al., 1999). Using data collected from this intervention within DiDiAC, I have investigated teachers' practices and students' participation in talk for learning while using microblogging. I will describe the intervention further in Section 4.1.1. In the next section, I will present why I believe microblogging and Thinking Together is interesting to use in an intervention aiming to promote classroom talk.

1.2 Microblogging within a pedagogical framework

Microblogging is a technology that has not yet been explored to a large extent in lower education but has been found to have great potential for promoting learning in higher education (Gao et al., 2012; Ludvigsen et al., 2019; Preston et al., 2015). Therefore, microblogging is an interesting technology to explore in secondary schools. In this thesis, the microblogging tool Talkwall is explored in a co-located manner, in which Talkwall is used with students physically present in the classroom. When microblogging is used co-located, students can write short messages, called microblogs, that are distributed to all participants in the classroom. The microblogs can function as temporary placeholder for students' ideas while they talk together in the classroom.

As with other educational technologies, teachers should think about how to embed microblogging in a pedagogical approach for it to be productive for learning purposes. Thus, the microblogging tool Talkwall, developed by teachers and researchers with this aim in mind, combines microblogging technology with a complementary research tradition, the dialogic classroom pedagogical approach Thinking Together. A central element of Thinking Together is bringing attention to the unspoken rules that dictate what is and is not acceptable in classroom talk (Mercer, 2002). The purposes and conventions of classroom talk are usually very different from everyday talk and often have some characteristics that distinguish it from talk in other situations. Usually, these rules are implicit understandings that are often based on historical precedent, such as when teachers ask questions (the teacher generally knows the answer to these questions) it is with the expectation that students raise their hands and wait for their turn to talk (Mercer & Littleton, 2007). When trying to involve students in the kind of talk that they learn from, such implicit rules can hinder their participation. Additionally, when using co-located microblogging, these implicit rules no longer apply in the same way because students have more flexibility in how they can participate in classroom talk. Therefore, an important aspect of the Thinking Together approach is that students and teachers develop a set of basic norms

for classroom talk called talk rules, which are to be used when students talk together (Mercer & Littleton, 2007). The concept of talk rules is central to this thesis, which will be explained further in Chapter 2.

From a sociocultural perspective, talk and social interaction are essential parts of learning. In addition to its communicative role in sharing knowledge, talk functions as an internal mode of thinking, meaning that talk is both a cultural and a psychological tool (Vygotsky, 1978; Wells, 1999; Wertsch, 1998). Adopting a sociocultural perspective enables me to explore the role of the microblogging tool, emphasising what teachers do to guide students' engagement in talk for learning using co-located microblogging and the students' uptake of how they can use talk to learn in interactions. By uptake, I mean when a student picks up on what the teacher has said and done and uses these elements in a conversation or discussion. Both language and digital technologies are embedded in culturally and historically developed practices and are consequently seen as part of the activity structure itself. I thus emphasise the role of social interaction in the construction of knowledge and understanding. The teacher is regarded as having the most central role in facilitating and guiding students' learning by offering timely and sufficient support, often referred to as scaffolding (Wood et al., 1976), in order for the students to reach their learning potential in areas such as language development. Examples of how a teacher can scaffold students' specific ways of talking is providing a simple prompt by asking an open question such as 'why?', followed by a pause (Kazak et al., 2015), or by specific talk prompts provided as card resources during group discussions (Maine & Hofmann, 2016). This type of scaffolding can include support from a group of students or even a whole class. When language is used in a scaffolding manner it can be regarded as both a communicative tool and a tool for collective thinking (Littleton & Mercer, 2013). The interaction between the explicit focus on talk for learning and enhanced access to digital has led scholars to pay increased attention to technology affordances. In the context of education and educational technology, affordance is often understood as action possibilities, meaning the possibilities that a specific environment provides to an actor (Kirschner, 2002; Major & Warwick, 2019). A key focus of scholarship on technology affordances has been on the mediating role of digital technology and how, for instance, the IWB can extend collective thinking beyond face-to-face situations (Littleton & Mercer, 2013). This is also the focus of the current thesis.

1.3 Research questions

The following research questions will be discussed in the extended abstract by drawing on the findings of three empirical studies reported in research articles which are included in part two of the thesis:

- What characterises teachers' emerging educational practices when combining an explicit focus on talk for learning and microblogging?
- In what ways can microblogging enhance students' participation in talk for learning?

Together, the three articles and the extended abstract contributes more knowledge to the literature about how teachers and students can engage in talk for learning by utilising digital technology.

1.4 Empirical work – Digital dialogues across the curriculum

The three studies that comprise the empirical foundation of this thesis are based on data collected from the DiDiAC project in 2016/2017.[1] This project was a collaboration between researchers from University of Oslo, Norway, and University of Cambridge, United Kingdom (UK). This design-based, teacher-researcher collaboration included 20 teachers specialising in different subjects (i.e. language, science, social studies and history) and their students from lower secondary schools in Norway and England.

The participating teachers were introduced to the 'Thinking Together' approach (Mercer et al., 1999) and to the microblogging tool Talkwall by researchers from the DiDiAC project group. As mentioned in the introduction, the idea of creating jointly established rules for talk is central to Thinking Together. The teachers and the students, therefore, created talk rules and discussed how these rules might help them interact in ways that are productive for learning. Teachers were also made familiar with the key functionalities of Talkwall, which is designed to support classroom talk. Talkwall is a microblogging tool, and the written contributions to Talkwall are called microblogs. Talkwall activities typically involve the formulation of a question or statement, followed by collaborative group discussion. The teacher and each group have access to their own wall as well as a side panel containing the 'feed'. After the group discussions, students can collaboratively write short contributions to Talkwall. The contributions are limited to 140 characters. All the microblogs are visible in the feed, and all participants have access to this feed; therefore, everyone can edit or elaborate on each other's contributions. Students and the teacher can pin contributions from the feed to their walls. The

---

[1] See Figure 1 in Section 4.1.1 for the data collection timeline.

contributions to the walls can be organised by the group or the teacher. Teachers can display the group walls or the teacher wall to all the participants with a classroom projector or an interactive whiteboard.

With data material collected from the DiDiAC project, I have conducted three empirical studies investigating different aspects of teaching practices that explicitly focus on talk for learning and microblogging. I will elaborate on the details of the three studies in Chapters 4 and 5.

1.5 Outline of the thesis

The thesis is organised into two sections. Part 1 is the extended abstract, consisting of six chapters that summarise and collate the research questions and conclusions of the three studies that constitute Part 2 of this thesis. In Chapter 1, I presented the research project by situating the current study in the research field. I have also contextualised and explained the background to and relevance of focusing on classroom talk and microblogging. Finally, in this first chapter, I have presented the research questions. In Chapter 2, I will lay out the basic assumptions of the sociocultural perspectives that underpin the research conducted for this thesis. I will also more deeply explain the central concepts of this thesis, including scaffolding, interthinking, dialogic classroom ethos and talk for learning. In Chapter 3, I will review previous research in this field, addressing ongoing discussions about classroom talk both with and without the presence of digital technology. This chapter will also consider challenges that teachers and researchers encounter when aiming to change established practices. Chapter 4 will provide details about the research design, the methods and the analytical procedures used for this study, and reflections about the research credibility. I will describe the empirical setting where the data collection for the research project was conducted, the methods that were used and the materials that were selected for the current thesis. I will also describe the three articles and provide a summary of the research questions, the analytical focus and the data types used in the three articles (see Table 1 in Section 4.2). Third, I will reflect on the ethical considerations and measures I have taken to ensure the research credibility of this thesis. Chapter 5 will briefly summarise each of the three articles before I discuss my findings and their implications in Chapter 6.

2 Theoretical perspectives

The three articles included in this thesis centre on the interactions between students and teachers who are engaged in microblogging activities and use talk rules as an important resource to promote talk for learning. In line with the overarching aim of this study, I employ a perspective that makes it possible to analyse how teachers and students work within settings reflecting the social practices and principles of schools, taken as cultural institutions. A sociocultural perspective considers culturally and historically developed practices, language and digital technologies parts of the activity structure. Therefore, it seems reasonable to base the analytical work on ideas emerging from a sociocultural perspective. I therefore emphasise the role of social interactions in the construction of knowledge and understanding. In this chapter, I will lay out the theoretical assumptions underpinning my research to situate the thesis in the sociocultural landscape. An important part of this chapter will be the presentation of central concepts that have been of analytical value for the empirical studies. The chapter is structured according to the development of the sociocultural perspective. By using such a structure, I intend to gradually narrow the focus to guide the reader through different parallel assumptions within this theoretical perspective. Consequently, the chapter can also be considered part of the rationale for the literature selected in the forthcoming review, constituting Chapter 3.

2.1 A sociocultural perspective

Constructivist ideas are often traced back to Piaget and Vygotsky. Piaget's theories mostly focus on individual development rather than the social features of learning. Yet, he did recognise the value of social interaction, especially peer interaction. However, in this thesis, I will pursue the sociocultural ideas of Vygotsky, who asserted that social interaction is the most important aspect of learning. He assumed that social interactions initiate learning, which lead to children's development. Learning and development are thus considered processes that appear first on a social level (intermental) and second on an individual level (intramental). At the centre of this process is the human language, our most important cultural tool or, as Cole (1994) expresses it, 'the master tool' that mediates the learning of all other tools (Wells, 1999). To understand language as a cultural tool, the concept of mediation is important. According to Vygotsky, human actions are always mediated through signs and tools; for example, signs are seen as internal structures for solving problems, such as symbols or concepts, and tools are artefacts, such as a pencil or a book. Human language has a communicative role in sharing

knowledge while also functioning as an internal mode of thinking. Thus, spoken language serves as both a psychological tool and a technical tool mediating human actions (Vygotsky, 1978). The concept of mediation by signs and tools has been further described by Wertsch (1998) as mediational means. Wertsch (1998) discusses the materiality of mediational means and emphasises that materiality is a property of any mediational means (p. 31). Even spoken language which seems to be an immaterial cultural tool that apparently evaporates moments after being spoken has its own materiality. In this thesis, I will use cultural tools or simply tools to include both signs (or psychological tools) and technical tools (Wertsch, 1998). One aspect of the materiality of spoken language will be highlighted and discussed in relation to the role of microblogging in Chapter 6.

To briefly recapitulate, the sociocultural perspective adopted in this thesis originates from the ideas of Vygotsky, and within this perspective, communication, thinking and learning are treated as processes shaped by culture. New understanding is thus co-constructed through interacting with others in a broad sense, for instance, with other people, texts, images and so on (Vygotsky, 1978; Wells, 1999; Wertsch, 1998). Following this line of thought in the current thesis, I assume that we are able to construct knowledge and new understanding through talk. Moreover, through talk, we are exposed to and provided with opportunities to be guided towards knowledge and new understanding. According to Vygotsky, our mental capacities are created by the internalisation of social interactions. Hence, we can consider learning as taking place when an individual interacts with others before that individual internalises the learning. Thus, learning can be guided by a more knowledgeable person.

2.1.1 Reinterpreting the idea of scaffolding

Another central idea articulated by Vygotsky is the zone of proximal development (ZPD). ZPD is defined as the area between the actual development level, characterised by individual problem-solving tasks, and the level of potential development, which is determined through problem-solving with the guidance of a more capable person (Vygotsky, 1978). The idea is that each child has an area of possible achievement that can be reached with help from a more capable person. This concept suggests that children's learning should focus on this area and on the potential of each child when working under the supervision or guidance of a more knowledgeable person.

Despite having a substantial impact on education and educational research, the concept of ZPD was underdeveloped because of Vygotsky's early death. His theoretical ideas were not yet finished, so he left us with a legacy open to many different interpretations (Valsiner & Van

der Veer, 2000). For example, he does not answer exactly how or in what ways children can be guided. Researchers thus build on ZPD, offering ideas such as the popular concept of scaffolding, which is usually associated with Wood and his colleagues (1976). They describe scaffolding as 'a process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts' (Wood et al., 1976, p. 90).

The initial idea of scaffolding learning is characterised by providing the right amount of temporary support, adapted to the students' needs. This support should be faded over time, before the responsibility for learning or the task at hand is transferred to the student (Wood et al., 1976). The scaffolding concept is based on research conducted on tutors, who supported children in completing a wooden jigsaw puzzle. In this study, the research team identified six forms of support that a more capable person can provide: (1) to engage the learner in the task, (2) to reduce the amount of freedom, (3) to maintain the student's focus, (4) to emphasise or focus the student's attention on critical features, (5) to control frustration and (6) to demonstrate or model solutions (Wood et al., 1976). Additional research emphasised the role of support through talk, especially to maintain the learners' focus (Bruner, 1978). Scaffolding in this way involves limited intervention. It has been highlighted that the support should be both contingent, meaning that that it adapts to the learner's developmental level, and temporary. Wood et al.'s (1976) studies of scaffolding were at the one-to-one level, with one adult providing scaffolds for one child.

In contrast to completing a concrete physical task, such as a jigsaw puzzle, educational activities concern more than the manipulation of physical objects, and the classroom contains many students and usually one or two teachers. Therefore, Mercer (1995) argued that to be useful, the concept of scaffolding must be 'reinterpreted to fit the classroom' (p. 74). This argument builds on the idea that in the classroom, learning addresses how to use language to represent ideas, interpret experiences and formulate and solve problems. To use language for school learning, students need the references and frames used by educational language. Teachers can therefore provide scaffolds to students by helping students apply frames of reference to the language that they lack experience in applying, for instance, by making the ground rules of talk in the classroom explicit and teaching students how they can use their language for thinking together to learn. This process involves more than two people, such as teachers and peers (Mercer, 1995).

Fernández et al. (2002) demonstrated that all the original functions of scaffolding, which were described by Wood et al. (1976), also can be found in some type of language use among collaborating peers. This is especially true when they are taught explicitly how to engage in

exploratory talk. Talk among peers is more symmetrical than teacher-student interactions, and peers do not intentionally try to scaffold each other's understanding. Yet, when students follow talk rules that they all agree upon, they scaffold each other's understanding simply by answering questions according to the talk rules while working together as peers during learning activities (Fernández et al., 2002). Thus, by re-conceptualising the initial notion of scaffolding, we can also consider the collaborative aspect of scaffolding and move beyond the idea of a tutor's conscious intentions of enabling a novice to accomplish a task. For the aim of the current study, which is to develop new knowledge about how teachers and students can utilise digital technology to enhance engagement in classroom talk that is beneficial for school learning, it is important to explore and consider the idea of providing scaffolding to students beyond the individual level and concrete, physical tasks.

2.1.2 The role of scaffolding in the classroom

Cazden (2001) advanced the scaffolding concept, pointing to the fact that scaffolding not only takes place on an individual level but can also be conducted on a group level through teachers' well-designed group instructions. Moreover, she emphasised that contexts and activities can also scaffold learning. She pointed to how the sequencing and structure of the curriculum, or the educational design, can scaffold learning if one activity prepares the students for the work they will do in the next (Cazden, 2001). In this thesis, and especially in Article 3, the educational design of the microblogging activities includes the teacher's planned activities and learning objectives. Planned activities and learning objectives are influenced by the school culture as well as the requirements of local and national curricula. Furthermore, the educational design includes the teacher's planned and enacted design, which occurs during the process of developing and realising learning intentions and can potentially scaffold students' learning (Cazden, 2001; Hauge et al., 2007).

In addition to designing educational activities, the idea that teachers can scaffold students in learning activities has been interpreted in several ways since its origin (van de Pol et al., 2010). In an educational context, scaffolding serves as the process that assists students in managing goals, tasks or activities that would not be possible individually. The teacher's role in scaffolding can be characterised as managing the affordances and constraints of the available tools to scaffold students' learning (van de Pol et al., 2010). The tools made available in the classroom will naturally vary with regard to the institutional context or culture. Here, it is relevant to the current thesis to emphasise that digital technology is part of the institutional culture.

Originally, the scaffolding concept was not developed with digital technologies in mind. However, the recent application of scaffolding to such contexts has proven useful (e.g. Arnseth & Krange, 2016; Pea, 2004; Tabak, 2004). For the current study, the concept of scaffolding is used to analyse classroom contexts in which microblogging is involved. Pea (2004) grouped the six scaffolding functions into three broader categories: channelling, focusing and modelling. In this thesis, my understanding is that channelling and focusing refer to how the teacher directs students towards task completion by reducing their degrees of freedom and constraining their actions. Modelling refers to teachers' demonstration of advanced solutions to solving tasks (Pea, 2004). These ideas can also be used to consider the role of digital technologies or activities involving the use of digital technologies. These analytical concepts allowed us to investigate the function of one teacher's guidance of learners in activities, including the microblogging tool, in Article 2.

Vygotsky's ideas of ZPD have also been developed from the original model (one-to-one support provided by a more knowledgeable person to an individual) to a more collective interpretation of the concept. Around the time that Cazden (2001) pointed to scaffolding on a group and curriculum level, Mercer (2002) introduced the concept of an 'intermental development zone' (IDZ). He explained how knowledge and understanding are only constructed when teachers and learners use talk and joint activities to create a shared communicative space, or IDZ, based on their common knowledge and aims. The IDZ is constantly developed through dialogue, and the teachers and learners have to negotiate their perspectives through the ongoing learning activity. The quality of the IDZ determines whether the teacher can enable the learners to reach new levels of knowledge and understanding (Littleton & Mercer, 2013). In this way, the IDZ allows the scaffolding concept to potentially include a group of students or even a whole class (Mercer & Littleton, 2007). Talk used in the shared communicative space is a tool for both communication and collective thinking or thinking together. Littleton and Mercer (2013) used the term interthinking. These authors also highlighted that interthinking can be taught explicitly, meaning that we can learn to engage more productively with each other's ideas. When using digital technologies such as microblogging, it is also possible to interthink through and with the technology, which potentially creates new opportunities for collective thinking.

However, new opportunities also pose some challenges. Interthinking with technologies requires the participants to be taught how to engage in the type of talk that enhances learning in digital environments. Here, an important consideration of using talk to create a shared communication space is the set of norms or ground rules that govern the patterns of all social

interactions (Mercer, 1995). In the next section, I will present the main ideas of ground rules or talk rules within a sociocultural perspective to provide a foundational understanding of talk rules, which is central to all three articles.

2.2 Language as a cultural tool

The sociocultural perspective focuses on our language and our talk as a cultural tool for learning and thinking (Wertsch, 1998). As such, it is important to highlight the fact that our language is part of our culture. Also, our language follows linguistic structures that decide the functions of what we say. Therefore, our language is embedded in both cultural conventions and language structures. Cultural conventions or norms for talk are often implicit understandings that we follow without further thought. When talking together, we do not simply listen and process the words being said, but we make sense of what is said primarily because of the situation, the purpose of the communication, the conventional norms that exist and the participants' common knowledge. These existing cultural norms are sometimes referred to as the ground rules of talk and can be general or specific (Edwards & Mercer, 1987; Grice, 1975).

2.2.1 Talk rules in the classroom

In all three articles, implicit ground rules form the basic understanding of how to utilise the potential within classroom talk when such talk is considered a tool for learning. Different settings have different ground rules for talk. Classroom talk has properties that distinguish it from talk in other situations, for example, the initiation-response-feedback/evaluation (IRF/IRE) structure and the dominance of teachers' questions (Mehan, 1979; Sinclair & Coulthard, 1975). I will not go further into detail about structural patterns but instead zoom in on the implicit understandings that exist within classrooms, which are often based on the historical precedents of such structural patterns.

Edwards and Mercer (1987) point to some examples of implicit understandings that are unique to classroom talk. For example, the teacher asks questions to which he or she knows the answer. Repeated questions imply that the students have answered incorrectly. Other than an instructional setting, where else would a person ask another person for the answer to a question that is already known and then repeat the question until the question is answered correctly? This is not to say that teachers should stop asking questions; doing so is a natural and important part of teachers' linguistic repertoire (Mercer & Littleton, 2007). The example illustrates some of the distinct characteristics of classroom talk and the often implicit ground rules for classroom talk, which can make participation in the kind of classroom talk that is beneficial for learning

challenging. Some of the ground rules that implicitly exist within every classroom are not aligned with the type of talk that students learn from. Through the interventions in the empirical studies included in this thesis, the teachers and the students therefore created their own ground rules or talk rules. These talk rules are explicit expressions of how students can use language to learn in conversations with others in the classroom. In Section 3.1.1, I will elaborate on the concept of talk rules.

If learning as a social phenomenon is mediated by cultural tools, then learning can be scaffolded (Bruner, 1978; Vygotsky, 1978; Wood et al., 1976). I use the concept of scaffolding in all three articles, although in slightly different ways. In Articles 1 and 2, we consider the talk rules, together with the teacher's explicit focus on them, as collective scaffolds intended to support students' talk for learning by focusing on the characteristics of exploratory talk. In Article 3, the idea of scaffolding is in line with Cazden (2001), as we consider the teachers' educational design to have a scaffolding presence by providing a structure for the students' talk through the timely activation of talk rules during the activities.

The concept of scaffolding is dynamic, and the scaffolding given by a teacher during an activity depends on both the activity and how the student responds to the provided scaffolds (van de Pol et al., 2010). Considering talk rules as collective scaffolds could possibly conflict with the ideas of both contingency and fading. However, whether talk rules can, in fact, be considered scaffolds will ultimately depend on how the teacher makes them relevant to the students' activities. In line with the sociocultural perspective and previous understandings of the scaffolding concept, these collective scaffolds need to be made relevant within the institutional context. For example, when a tool such as Talkwall is introduced, the talk rules might need to be (re-)activated according to the situation to be relevant for the students as scaffolds.

To summarise, from a sociocultural perspective, our language is considered a cultural tool for thinking and learning. This means that our use of language in communication with others depends on existing cultural norms. These norms are often implicit and specific to different situations, including classrooms. Making explicit talk rules can be beneficial in the classroom during the process of constructing knowledge through interactions.

2.2.2 Teaching talk for learning

Theoretical assumptions within the sociocultural perspective consider talk an essential tool for learning. It is necessary to learn how to make use of talk in various ways for it to be productive for learning school subjects. Knowing how to use talk for learning in various

educational situations requires that talk itself is considered a subject that needs to be learned in addition to being a medium for learning.

In the three articles included in this thesis, I use the broad concept of productive interactions, which I also refer to as talk for learning, to describe interactions in which participants use talk as a tool for constructing new knowledge and understanding (Barnes, 2008). I use the idea of talk for learning when specifying the use of spoken language for constructing knowledge and trying new ways of understanding school subjects in whole-class activities and collaborative group work (Articles 1 and 2). I distinguish the idea of talk for learning from Vygotsky's more general understanding of the use of human language to share knowledge and to think internally. In this thesis, I focus on the particular use of spoken language when teaching and learning school subjects. Hence, I consider the teaching of talk for learning to be the explicit teaching of speaking and listening skills for subject learning, and as a specific approach to oral language as the primary tool for thinking (Mercer, 2000; Vygotsky, 1986).

Considering talk for learning as a subject that needs to be learned also suggests that knowing how to talk for learning ought to be taught explicitly and, as such, can be scaffolded by either a more knowledgeable person or the educational design. If teachers are to teach students how to talk for learning, they need strategies for doing so. For the purpose of this thesis, I consider teachers' strategies to be methods and techniques, or ways of acting in the classroom. Another important concern of this thesis is the classroom ethos. To engage students in talk for learning, it is essential for teachers to establish a classroom ethos that fosters talk for learning by creating a classroom environment that provides students with opportunities to express themselves, think together and co-construct knowledge and new understanding (Mercer & Littleton, 2007; Wells, 2009). The teachers' strategies, the establishment of this type of classroom ethos and the explicit talk rules are interrelated. In the next chapter, I will review some of the literature considering various approaches to achieving a classroom ethos that fosters talk for learning.

In this study, I have employed a sociocultural perspective to explore how teachers can promote students' talk for learning in combination with microblogging and to investigate the teachers' educational design of activities that involve co-located microblogging. As thinking and learning are considered to be mediated by cultural tools in social interactions, classroom talk is embedded in an institutional culture (Wertsch, 1998). Regarding talk as an important tool for thinking also indicates that students can be guided towards new understanding by a more knowledgeable person. These assumptions suggest that it is essential for teachers to provide scaffolds for their students when teaching them how to use talk as a tool for learning.

Teachers' and students' collective creation and establishment of talk rules can provide an important scaffold for students in developing their use of talk for learning. In the following chapter, I will review previous studies focusing on various ways of promoting productive forms of classroom talk.

3 Review of the relevant research

Each of the three articles includes literature reviews relevant for the specific topics that are discussed in the articles. In the extended abstract the literature review intends to both add nuance to the reviews in the journal articles, but it can also be read as an independent literature review of relevant research. Thus, I have divided the review in this extended abstract into four parts as follows. In the first part, I will provide a simplified map of the field and chronologically present the key studies on classroom talk, thus directing the path of the current thesis. This is by no means a complete map of all the research in this field, but rather a careful selection of studies that are relevant to the topics in this thesis. In the second part, I will review selected literature about studies that have focused on making talk rules explicit as a means to support classroom talk for learning. I have selected studies that used digital technology because of their relevance to the current study. In the third part, I will present a selection of literature considering how microblogging can promote talk for learning. In the last part, I will review the recent literature resulting from the DiDiAC project, of which this study is a part, and consider the role of the microblogging tool Talkwall in relation to the pedagogical approach Thinking Together.

3.1 Classroom talk

For decades, several influential researchers have investigated students' spoken language competencies. In the early studies of classroom talk the main concern was language structures rather than meaning. In these studies researchers used for instance survey methods or observations to categorise observable features of classroom talk often associated with teacher effectiveness (e.g. Flanders, 1970; Galton et al., 1999). During the 1960s, researchers also investigated students' spoken language skills (Bernstein, 1975; Heath, 1983). One example is Shirley Brice Heath's (1983) classic study, revealing how the culture and 'ways with words' in children's home environments did not match those in school, and she argue that students needed to be guided in academic dialogue (Heath, 1983). Later researchers started to use ethnographic approaches and transcripts to analyse language structures in the classroom. It was during this period in the 1970s that researchers found out that most interactions between students and

teacher was structured as initiation-response-evaluation/feedback (IRE/IRF) (Mehan, 1979; Sinclair & Coulthard, 1975). Around the same time, researchers started to gain interest in the function and form of language. Barnes and Todd (1977), for example, investigated students' classroom talk and discovered how young students carry out collaborative learning in small groups when the educational design of the activity facilitates learning. They identified exploratory talk in small group interactions, which is a form of talk that has particular potential for learning. Later, Wood et al. (1976) and Bruner (1978) performed research on children and tutors and introduced the scaffolding concept, as explained in Chapter 2.

During the 1990s, some researchers were critical of the IRE/IRF structure, leading to the recommendation that teachers avoid this structure and minimise questions. Wells (1999), on the other hand, recognised the importance of studying both the form and function of language. Through careful analysis, he showed how teachers' questions can serve an important purpose by guiding students' learning and developing students' use of language (Wells, 1999). In the same period, Mercer (1995) typified three ways of student talk: (1) disputational, (2) cumulative and, inspired by Barnes and Todd (1977), (3) exploratory talk. Mercer (2002) defines exploratory talk as:

> Exploratory talk is that in which partners engage critically but constructively with each other's ideas. Relevant information is offered for joint consideration. Proposals may be challenged and counter-challenged, but if so, reasons are given and alternatives are offered. Agreement is sought as a basis for joint progress. Knowledge is made publicly accountable and reasoning is visible in the talk. (p. 98)

The insight that teachers could potentially guide their students' learning and develop their use of language led many researchers to study and develop approaches that could potentially support student's engagement in talk for learning.

3.1.1 Approaches to teaching students how to talk for learning

Throughout the last three decades, there has been research interest in developing and studying the impact of specific approaches and frameworks to teaching talk for learning. Palinscar and Brown (1984) introduced one such model, reciprocal teaching, for teaching reading comprehension strategies through careful guidance and scaffolded talk. Bereiter and Scardamalia (1987) presented a technology feature to support procedural facilitation for fostering expertise writing. This is a type of prompt or sentence opener within the CSILE[2]/Knowledge Forum technology that is intended to scaffold students who are engaged in

---

[2] Computer-Supported Intentional Learning Environment

knowledge building activities. Examples of such 'sentence opener' scaffolds are, 'My theory is...', or, 'I need to understand... '. Similar approaches using prompts has also been explored without technology use. For instance, within the development of children's reading comprehension, the use of Talk Prompts provided as card resources, such as 'perhaps'… and 'I wonder if…', or 'I think…because…', has been suggested as a tool that teachers can use to model and encourage comprehension strategies for the children (Maine & Hofmann, 2016).

Collaborative reasoning is a framework that helps teachers scaffold small-group discussions about children's stories. Collaborative reasoning provides teachers with a structured repertoire of strategies to use, suggesting that students follow basic ground rules provided by the teacher during the discussions. Through discussions, children are encouraged to listen to one another, to think aloud and to learn how they can engage in reasoned argumentation (Clark et al., 2003). Likewise, Accountable talk focuses on strengthening students' communication skills and respect for one another during peer talk. This approach emphasises forms and ground rules for talk that support and promote equity and access to talk for learning (Michaels et al., 2016).

Another approach is Thinking Together. The overall intent of Thinking Together is engagement in talk for learning, whereby students share ideas and co-create joint perspectives. This approach includes materials and lesson activities that can enhance teachers' repertoire and are used for scaffolding students who are developing their talk for learning (Mercer et al., 1999). A central aspect of this approach is that the teacher and the students co-create and agree upon explicit talk rules that can support students in taking advantage of language as a tool for thinking (Mercer et al., 1999). These talk rules should embody the characteristics of exploratory talk (Barnes & Todd, 1977; Mercer & Littleton, 2007). For example, in my studies, many of the participating classes created talk rules such as 'we share ideas with each other, we respect that others have a different opinion, and we provide reasons for our answers'. Importantly, the explicit talk rules that have been created should neither be considered the only correct way of talking nor require students to change their usual way of talking. The talk rules are simply supposed to guide students into using their language efficiently as a tool for learning (Mercer & Littleton, 2007). When focusing on talk rules, the teacher should meaningfully include these rules in various classroom activities to support students' engagement in talk for learning (Mercer, 2002; Michaels et al., 2016). Hence, it is important that the focus on talk rules is conducted with a dialogic intention or in other words with an underlying principle of engaging students in talk for learning.

The current thesis builds on many ideas from Thinking Together. In Section 3.2, I will review relevant studies that have specifically investigated the Thinking Together approach. Before I introduce these studies, I present the main ideas of a related concept that, for the past two decades, has been considered important to research on classroom talk: dialogic teaching.

3.1.2 Dialogic teaching

Dialogic teaching broadly describes a range of different approaches and practices, such as those presented above. Dialogic teaching can also be considered akin to a value system that encourages and enables students to actively collaborate in the classroom community through dialogue (Alexander, 2008; Wells, 1999). The term dialogic can be defined as follows:

> 'Dialogic' refers to the way in which speakers' utterances are always simultaneously orientated, in terms of their structure and context, in two directions: backwards towards previous utterances, both within the current conversation and through memory in past conversations, and forwards, towards an audience (and possibly future audiences). (Maybin, 2006, p. 23)

This understanding of dialogic processes is often traced back to the work of Bakhtin (1986). Bakhtin wrote that every utterance is always partly a response to things that have been said before and thus also anticipates the responses expected of its speaker. This means that there are always at least two voices doing the talking, because every utterance is, in part, a response to things that have been said before. New meaning-making or understanding can therefore be said to develop in the tension between different perspectives, opening up what is called a dialogic space when two or more perspectives are held in tension (Wegerif, 2007). These insights lend to the current thesis the premise that dialogic teaching entails a particular classroom culture or a value system for a certain classroom culture. According to Alexander (2008), 'dialogic teaching involves both teachers and students making substantial and significant contributions and addressing learning activities together' (p. 28). Also, teachers and students listen to each other in a supportive environment and build on each other's ideas. The teacher plays an important role in scaffolding the students throughout this process by careful planning according to curricular goals (Alexander, 2008).[3]

The theoretical perspectives in Chapter 2 asserted that an important part of promoting talk for learning is establishing a classroom ethos that increases opportunities to take part in talk for learning. In light of what I have just presented about dialogic teaching, this type of

---

[3] Dialogic teaching according to (Alexander, 2008) is brought together in five principles which is that is has to be collective, reciprocal, supportive, cumulative and purposeful (p. 28).

classroom ethos can be considered a dialogic classroom ethos. In Article 3, I use this concept to account for the teacher's work towards creating a classroom culture that promotes talk for learning in her class. One aspect on which I focus is how the teacher maintains a broad repertoire of strategies to accomplish this goal.

In summary, both the concept of dialogic teaching and more specific approaches to scaffolding classroom talk have the same overall focus on creating a classroom ethos that supports students' active participation in talk that promotes learning. My understanding here is that to promote talk for learning, teachers are not restricted to one specific way of teaching. Rather, the aim is for teachers to have a repertoire of teaching strategies that support and enhance classroom talk for learning, and establish a classroom ethos where talk for learning is enhanced. Hence, considering the theoretical perspective that I take in this thesis, language skills or tools needed to engage in talk for learning benefit from being explicitly taught through active participation in a classroom culture that is guiding and supportive.

3.2 Thinking together with computers

As mentioned, the current study builds on research from the Thinking Together approach and research suggesting how digital technology can enhance classroom talk for learning. In the following, I present selected studies on digital technology relevant to the current thesis and indicate the ways in which digital technology has been found to enhance talk for learning. In this part of the review, I will only include studies that have explicitly focused on teaching talk for learning using talk rules. In Section 3.3, I will also include key studies about microblogging, although these do not consider the explicit teaching of talk for learning.

3.2.1 Interactive whiteboard studies

Several studies have explored the technology affordances of IWBs for enhancing classroom talk for learning. The selected studies point to different aspects of this tool. For instance, Hennessy (2011) studied teacher led IWB use and suggested the potential within this tool for creating a dialogic space for reflection where teachers can elicit contrasting ideas and students can construct and collaborate around digital artefacts. The talk rules and jointly established ideas about exploratory talk ensure the openness and maintenance of the 'dialogic space of reflection' (Hennessy, 2011; Wegerif, 2007). Considering the technology affordance of opening a dialogic space, Kershner et al. (2010) explored how students in primary classrooms collaborated on a variety of science activities using an IWB. Similar to the current thesis, the researcher in this study introduced talk rules as a scaffolding resource. The results from this

research suggested that students who collaboratively use the IWB can effectively engage in a collective learning experience that the authors called a 'shared dynamic dialogic space'. However, the IWB was not perceived a distinctive learning resource along the lines of Talkwall. The authors articulated the close relationship between (1) how students construct knowledge and new understanding and (2) how they actively engage with IWB affordances and talk for learning. Warwick et al. (2010) made the same argument, concluding that the IWB could serve as both a tool and a learning environment, which could encourage the creation of a joint dialogic space for constructing new knowledge and understanding. Still, the key to opening this space is the teachers' scaffolding of the group interactions and the technology.

Essentially, opening a shared dynamic dialogic space needs support from the teacher's scaffolding strategies, the establishment of and focus on talk rules and a classroom ethos that could create opportunities for students' participation.

3.2.2 Changing structures and rules

Kerawalla (2015) and Kerawalla et al. (2013) investigated the online tool Talk Factory, which is designed to model and present talk rules for exploratory talk on an IWB. Through this tool, the class talk rules are displayed on the IWB, and the teacher can simultaneously remain informed about and evaluate the students' talk throughout the lesson, as the results from the students' discussions dynamically appear on a graph. Their findings indicated that the tool altered the nature of students' talk, resulting in more exploratory talk, and changed the learning environment, increasing a sense of community feeling (Kerawalla et al., 2013). The Talk Factory studies demonstrated how a digital tool can make explicit the talk rules for exploratory talk. As in the current study, the authors focused on how the talk rules are important scaffolds for the students' talk for learning in both group and whole-class settings. However, the study did not address the use of Talk Factory across subjects other than science and did not consider the teachers' strategies to scaffold students' talk besides monitoring and evaluation.

The potential of technology to promote a new type of interaction has been addressed by several studies (Wegerif, 1996, 2007; Wegerif & Dawes, 2004). As part of the Thinking Together approach, the researchers developed an interactive tool designed to bring out students' exploratory talk through a narrative. They built on the IRF structure and suggested that technology could provide an opportunity for developing this structure into initiation-discussion-response-feedback (IDRF) structure, where the "D" stands for "Discussion". This structure includes a phase in which the students could sit back from the computer and engage in peer talk about their responses. Wegerif (2007) suggested that the IDRF represented what he called

computer-supported ZPD because the students were interacting with the computer. This structure indicated that an element of talk for learning between students was inserted into what would otherwise be a limited IRF teaching exchange (Wegerif, 1996). Here, technology affordances functioned as scaffolds for collective interthinking. For this to occur, the educational design had to facilitate engagement, with the computer paused while the students talked together. Furthermore, the students who benefited most from engaging with this technology and who engaged in significantly more exploratory talk were those who were introduced to the Thinking Together approach, focusing explicitly on the talk rules (Mercer et al., 2003).

As with the disruption of the IRF structure, using digital technology might also change the way students interact with each other. Staarman (2009) found that introducing a new digital tool into the classroom changed the nature of classroom interaction and collaboration. This required a re-establishment of the established talk rules that this class had developed to make the talk rules relevant when using the new digital technology. Staarman (2009) argued that when a new digital tool, CSILE/Knowledge Forum (Scardamalia, 2004), was introduced to the class, the purpose and use of the rules for talk required further discussion between the teacher and students, re-establishing their usefulness in relation to the new tool.

3.2.3 Between fluidity and permanence

The use of digital technologies can foster possibilities for new, rich forms of interaction by enabling multiple modes of representation (Wegerif, 2007). Multimodal approaches to teaching are not restricted to digital technology; rather, technology opens up more opportunities for interaction.

In relation to classroom talk, the literature has pointed to the benefits of using multimodal representations to create continuity between ideas and events in a meaning-making trajectory. Other studies that use the Thinking Together approach, again in combination with an IWB, found the digital tool useful for generating and saving written co-constructed conclusions. This type of text, called a 'digital improvable object' (Twiner et al., 2010, 2021), is a written note resulting from group work that should be treated as an improvable object rather than a finished piece of work (Wells, 1999) and could offer a 'halfway stage between the ephemerality of talk and the permanence of written texts' (Littleton & Mercer, 2013, p. 77). This halfway stage represents an example of how technology can support students in thinking collectively. When a digital improvable object is composed on the IWB, it is easy for a

collaborative group to see and comment on what each member has written. In this way, digital technology opens up various ways of presenting content.

Using technology to host content can also scaffold the students, highlighting or helping them remember specific focus points. Technology can, as such, be used to 'give permanence to what is said' (Wells, 1999, p. 116). However, it is also important to consider the talk rules for how to treat such improvable objects so that the students do not consider them finalised public presentations. Technology affordances will only emerge if they align with the established classroom culture (Littleton & Mercer, 2013). In Article 3, we also consider an aspect of the material dimension of spoken language (Wertsch, 1998), discussing how microblogging can add a form of semi permanence to the fluid spoken language through its short and informal microblog format, making the microblogs 'digital improvable objects' (Twiner et al., 2010, 2021) that enable students' collective thinking. This will be discussed further in Chapter 6.

Within studies focusing on the explicit teaching of talk for learning by using talk rules and digital technology, the IWB has dominated for its potential to create a dialogic space. Technologies, such as Talk Factory and the interactive narrative, changed the structure of classroom talk. Together, these studies are valuable contributions to my empirical studies and will be further discussed in relation to Articles 1, 2 and 3 in Chapter 6.

In the next section, I will consider the literature about microblogging in education, providing a short introduction to the development of this technology and considering the various ways of using microblogging in education. As mentioned, most studies were conducted in higher education. Yet, they have been selected for their generic consideration of microblogging; therefore, the students' age is not an issue here.

3.3 The use of microblogging in education

Microblogging is the process of posting short messages in a shared digital environment, where every participant can read these messages. Twitter, perhaps the most well-known commercial example, is used to share ideas and information worldwide. Besides Twitter, there are several other microblogging platforms serving various purposes. Within education, the use of microblogging has been widely explored throughout the last decade. In this section, I will review some studies that have inspired the development of the specific microblogging tool Talkwall and present researchers' findings on the various uses of microblogging in education. Since few studies focus on how microblogging can be used in classrooms to support or promote oral classroom talk, I will include literature on microblogging in classrooms for various purposes.

Within education, microblogging can be used as a collaborative virtual environment that has been found to potentially promote learning. Gao et al. (2012) reviewed 21 studies (all but one were from higher education or conferences) on microblogging in education. In these studies, microblogging changed the learning activities by transforming the participation and interaction structures. For instance, microblogging enabled every participant to instantly take part in activities, which led to increased participation and engagement. Moreover, microblogging can potentially (1) lead to the formation of a learning community and (2) support collaborative activities. Also, microblogging allows the teacher or instructor to exchange ideas with students in a timely manner (Gao et al., 2012).

One interesting finding from a study about the use of the microblogging tool Tweeducate, together with face-to-face discussions, was that this combination resulted in both a high quantity and a high quality of student participation during a graduate course (Luo & Gao, 2012). The authors argued for the importance of the teachers' educational design, which had to provide the students with rules and guidelines, scaffolding the tweeting activities. A related study of microblogging took place in a college-level course. The findings revealed that students who received guidance from their instructor, in terms of support to eliminate distractions and reduce extraneous cognitive load, achieved higher levels of learning, especially with regard to focusing on the task and thinking deeply (Luo, 2015).

Another central finding from studies of microblogging in classrooms is that teachers can be provided with insight into small-group discussions. Mercier et al. (2015) described a design experiment conducted in two undergraduate classes using Twitter for discussion activities during class. The authors reported that from the teacher's perspective, Twitter enabled teachers to direct the final conversations of a topic by addressing tweets. Furthermore, teachers could use the tweets to ask the groups who wrote them to expand upon or explain them and to ask other groups to comment on the tweeted ideas. Doing so allowed for more detailed discussions. Like Luo (2015), Mercier and colleagues (2015) found that Twitter kept students focused on tasks. The students reported that they obtained good ideas from other students' tweets and that the tweets were useful for whole-class discussions (Mercier et al., 2015). The authors of a more recent article discussed the affordances of using the online whiteboard Flinga.fi in large university lectures for opening, widening and deepening dialogic spaces (Ludvigsen et al., 2019). The educational design shifted between whole-class lectures and discussions and small-group discussions. The findings suggested that the students were introduced to different perspectives through the microblogs, which widened and deepened their own discussions in both small groups and whole class. Similar to other studies of in-class

microblogging, this study identified the potential to increase interactions among students and between students and lecturers. Interestingly, this study did not explicitly comment on the existing ground rules for interaction within large lectures. Still, the authors argued that technology has the potential to transform a lecture with many participants into a space of dialogue and reflection. Moreover, they expressed the importance creating of a learning environment that supports the underlying conditions enabling students to be open with each other, to be curious about each other's ideas and to respect each other's opinions (Ludvigsen et al., 2019).

In summary, what emerges from the studies of in-class microblogging is the idea that microblogging tools can potentially transform learning activities and support talk for learning by facilitating more perspectives and enabling more participants to enter the dialogue, thus creating a collaborative learning environment. Just as with the use of IWBs and other tools, the importance of the teacher, who provides clear guidelines and scaffolds, is highlighted in microblogging studies. Also emphasised is the establishment of a classroom culture that enables talk for learning in both written and oral discussions.

In the final part of the review, I will zoom in on the use of Talkwall in the classroom to enhance students' talk for learning.

3.4 Teachers' use of Talkwall to promote classroom talk for learning

Talkwall is a microblogging tool that has been developed through an iterative design and development approach (Smørdal et al., 2021). The early design was an integrated chat in a wiki environment (Lund & Rasmussen, 2008). Key insights from teachers using the tool informed the design's shift from a chat to a microblogging tool. This microblogging tool, named 'Socius', was developed in close collaboration with teachers and designed to produce and display microblogs in classrooms. Rasmussen and Hagen (2015) investigated how students engaged in individual work with microblogging and how the students and the teacher engaged in whole-class discussions supported by microblogging. They found that the lessons were characterised by the display of microblogs, combined with the students' and teacher's elaborations of the blog content. The various modalities present in this lesson (text and talk) and the teacher's elaborations of the students' own contributions brought the teacher's and students' knowledge and new understanding of the topic closer together, and the whole-class discussion emerged from the students' own work. The teacher also used the students' ideas as a starting point in his elaborating upon, questioning of and connecting the ideas. Sharing and displaying the students' microblogs showed the students' ongoing understanding of the content

and made an important contribution to the whole-class discussion. Still, the teacher played the most crucial role in making the whole-class talk productive in terms of understanding the topic. Finally, this study highlighted the need to adapt the educational design of the learning activities to new technologies that enter classrooms (Rasmussen & Hagen, 2015). The findings from Rasmussen and Hagen (2015), combined with further collaboration with teachers and students, led to a new iteration of the microblogging tool, now called Talkwall.

Talkwall has now been studied in classrooms in both Norway and England. These studies have investigated how the combination of Talkwall and the Thinking Together approach can enhance classroom talk for learning. However, these studies focused on various aspects of the combination of Talkwall and Thinking Together; therefore, in the following, I will review the studies according to their unique focus.

In one Talkwall study, Frøytlog and Rasmussen (2020) investigated how Talkwall can give more students the opportunity to participate in whole-class talk, thus increasing their opportunities to think and learn together. They found that Talkwall, when used in whole-class discussions, was mostly used to connect the whole-class talk to the prior group talks. This finding illustrates that the most frequent use of the tool allowed cognitive resources to be connected and shared across different learning activities. Another finding from their study was that when Talkwall was projected onto the teacher's whiteboard, the teacher frequently asked for elaborations upon or reasons for the student contributions. According to Howe et al. (2019), the strategy most strongly correlated with learning outcomes is elaboration. Though the practice of asking for elaborations upon Talkwall contributions might resemble the traditional IRF structure, communication via Talkwall was not teacher-centred. Furthermore, the students' voices were advanced by the teacher through the tool. Frøytlog and Rasmussen (2020) point to Talkwall as an important support for teachers facilitating whole-class talks that are widely distributed. The use of Talkwall can strengthen participation and make whole-class talk a collective undertaking, in contrast to typical whole-class talks that involve only a few students (Black, 2004; Sedlacek & Sedova, 2017).

Omland and Rødnes (2020) considered the role of Talkwall in building students' agency. They demonstrated how teachers can practice specific strategies – such as asking open questions, modelling thinking strategies and acknowledging students' contributions in Talkwall – to position the students as competent members of the class, thereby contributing to building their agency. Talkwall was promoted as a mediating tool for classroom talk, which led to frequent shifts in the activities, providing variation. This gave the students diverse opportunities to participate in both whole-class and group talk. In her latest article, Omland (2021)

demonstrated how group talk can allow for interruptions and informal utterances, indicating the need for elaboration. Moreover, the article showed how the teacher's manner when picking up on students' Talkwall contributions made the students accountable for what was said in the group. The teacher's uptake and additional requests for elaboration created space for the students' voices in the whole-class discussion. The authors used the term 'guided interthinking' to describe how the teacher built upon the students' ideas. Guided interthinking can be conceived of in two ways: (1) the mutual scaffold of the peers in the group and (2) the teacher's guidance. According to Omland (2021), Talkwall allowed ideas from different groups to enter other groups' discussions, widened the dialogic space and expanded the students' interthinking.

One article by Rødnes et al. (2021) and a book chapter from Rasmussen and Rødnes (2020) have explored one teacher's work with the academic concept of power in a multicultural classroom. The two studies were based on one teacher's lesson. The authors explored the role that Talkwall played in this lesson, investigating (1) how students and their teacher interacted to develop a shared understanding of power and (2) how the teacher, through her educational design and facilitation, could balance the students' collaborative exploration of the concept with an academic understanding. First, the teacher emphasised the role of talk rules in the students' group talks because the students were obligated to listen to everyone and reach an agreement before they contributed to Talkwall. Moreover, the students' everyday understanding was acknowledged as being important to their participation (Rasmussen & Rødnes, 2020; Rødnes et al., 2021). The teacher encompassed this strategy, which contributed to a high level of student participation. This strategy was also used to balance exploration and an academic understanding of the concept of power. While the teacher used the students' everyday understanding, she concurrently provided them with direction towards an academic understanding. As in other Talkwall studies (Cook et al., 2019, 2020; Frøytlog & Rasmussen, 2020; Omland, 2021; Omland & Rødnes, 2020), Talkwall's role in providing students with opportunities to express ideas in group talk and in whole-class talk was highlighted. Talkwall, in combination with the teacher's use of the contributions as tools for thinking together, allowed the students to contribute, even if they remained unable to precisely use the academic concept. Rødnes et al. (2021) also demonstrated how the teacher's engagement with students' contributions was crucial for scaffolding their talk for learning. The teacher had to carefully consider when to allow students time to elaborate and explore and also when to limit the students' contributions and support the students in their reasoning.

Warwick et al. (2020) argued that joint teacher and student awareness of the dialogic intention can scaffold the students' talk for learning when using Talkwall. By systematically

analysing the students' interactions in group talk that used Talkwall, the authors revealed that functionalities within the technology were supported or constrained by the realisation of dialogic intentions. The article is specifically interesting for its examination of how engagement in classroom talk for learning could be scaffolded by focusing on dialogic learning intentions.

3.5 Positioning of the thesis

What emerges from the literature presented in this chapter is that earlier studies found that the use of digital technology has the potential to enhance students' classroom talk. Yet, few studies have investigated digital technology that is specifically developed to support classroom talk in combination with a dialogic teaching approach. There are studies on how technology can be used to support classroom talk. However, in these studies, digital technology was often used as a temporary support when, for example, introducing specific ways of talking together (Kerawalla, 2015; Kerawalla et al., 2013) or presenting multimodal content for practicing talk for learning skills (Wegerif et al., 1998). Within research on the Thinking Together approach, early studies focused on IWB technology. Previous studies on microblogging have often been carried out in higher education (Tang & Hew, 2017). Few microblogging studies conducted in higher education pay specific attention to introducing talk rules as a support for classroom talk (Gao et al., 2012; Ludvigsen et al., 2019).

The recent microblogging studies outlined in Section 3.4 variously investigated how the combination of microblogging and the explicit focus on talk for learning enhanced students' opportunities to talk together to learn. Although these studies all emphasised the importance of focusing explicitly on teaching talk for learning, these microblogging studies did not consider: (1) teachers' strategies across classrooms to support students' talk for learning when using co-located microblogging technology, (2) how explicit focus on talk for learning might or might not be supported by microblogging, (3) how the students pick up on and manage to use the various tools intended to support talk for learning in their peer discussions and (4) what characterises teachers' educational design of microblogging activities with the aim of supporting students talk for learning. The current thesis will address these gaps in the literature by investigating (1) teachers' strategies and educational designs and (2) how students discuss in groups during microblogging activities with an explicit focus on talk for learning. Hence, this thesis will contribute more knowledge about how teachers can use digital technology such as microblogging to support students' talk for learning.

In the following chapter, I will describe the empirical context of the three studies and present the research design, methods and analytical procedures that I have taken in the current thesis.

4 Research design and methods

In this chapter, I will account for the overall research design and the methods applied in the three articles. The short format of journal articles does not allow for reflections about the choices of methods, which consequently often become very compact. This chapter can be considered a supplement to the discussions in the articles, fulfilling my goal to elaborate and reflect upon issues regarding these choices of methods. Because the data was collected as part of a larger project, the chapter begins with an overview of the research design of DiDiAC. I will also reflect on the possibilities and limitations of the framework of my study. Then, I will present the methods used in each study and present the data that was analysed. This will be followed by an account of the challenges and weaknesses regarding the research design before I reflect on the ethical issues. Last, I will discuss the reliability, validity and possible generalisations of the findings from this study.

4.1 Research design

4.1.1 DiDiAC: A design-based research project

The larger research project DiDiAC utilises a design-based research (DBR) approach that is grounded in a collaborative partnership between teachers, researchers and technology developers (Lund et al., 2010; Lund & Rasmussen, 2008). The DiDiAC team consisted of eight researchers from Norway, four researchers from the UK, teachers from both the UK and Norway, as well as their students, and a team of developers and designers from the university lab.[4] The idea behind the DBR approach was to employ theory and research findings, combined with an iterative use of technology, in real classroom settings. The research design was informed by previous literature about DBR interventions, the researchers' experiences with earlier projects and a pilot study conducted prior to the classroom interventions.

The DBR tradition, on which the DiDiAC project builds, is often associated with the work of Brown (1992) and Collins (1992), who introduced design experiments as an innovative approach to conducting research within education. In early DBR studies, the main objective

---

[4] EngageLab, UiO, https://www.uv.uio.no/iped/english/about/engagelab/index.html

was to move educational experiments from laboratories to naturalistic contexts to develop and work with practical theories and methods. DBR, in some cases, is considered a hypothesis-driven approach to theory development. The aims of doing DBR are therefore to develop and refine the design of artefacts, tools and curricula and to advance existing theories that can lead to a deeper understanding of learning (Barab, 2006). Moreover, an additional aim can be to generate new theories and frameworks for conceptualising learning, instruction, design processes and educational reform. As a researcher, I consider the goals of doing a DBR study to be both grand and ambitious; thus, my study should not be considered an attempt to generate new theories or frameworks. However, I believe that my study can refine existing theories about how we understand the use of digital technology to support classroom talk. Moreover, I believe the current study contributes new understanding to scholarship that can be useful for teacher practices and strategies that support students in talking together in ways that are beneficial for learning (Barab, 2006).

By using the DBR approach, the DiDiAC researchers were able to try out the combination of theoretical principles, derived from prior research on Talkwall (e.g. Lund et al., 2010; Rasmussen & Hagen, 2015) and Thinking Together (Mercer et al., 1999), in naturalistic classroom situations. This way of performing interventions can inform practice to a larger degree than, for instance, controlled studies in laboratories or ethnographic studies (Brown, 1992; Collins, 1992). We analysed how the teachers and students activated Talkwall and Thinking Together and how classroom practices emerged from this use. In line with the sociocultural perspective presented earlier, I acknowledge that situated activities need to be analysed as social practices.

As illustrated in Figure 1, the data collection and fieldwork of DiDiAC was carried out during one school year (2016/2017). I was introduced to the project during the spring semester of 2017. At this time, two small pilot studies on Talkwall (not combined with Thinking Together) had already been conducted and evaluated (2016), and the main data collection began. The data collection (Figure 1) for the main project was a collective endeavour to which all DiDiAC members contributed. However, one researcher held the main responsibility for one school and therefore maintained primary communication with the teachers from the different schools.

The data collection began with video-recorded workshops (one in the UK and one in Norway) in 2016, to which all the teachers were invited. During this workshop, the teachers were introduced to the theoretical perspectives of Thinking Together and familiarised with Talkwall. The data collection from each individual classroom began in the spring semester of

31

2017 and was carried out over the course of six months. Teachers and their students were video recorded during three lessons (some during only two lessons) in a subject of their own choice. Between each lesson, the teachers met with researchers for a joint discussion. During these meetings, video recordings from the teachers' lessons were used as a reflective tool to discuss selected incidents from the recordings while focusing on specific aspects of the teachers' practice (Vrikki et al., 2021). These meetings were audio recorded. The meetings were also used to gain feedback on the design aspects of Talkwall, and iterations made to the tool were based on this feedback. After the main data collection of the video-recorded lessons, the teachers and groups of students were interviewed. The interviews were audio recorded.

Figure 1

Data collection timeline

Autumn 2016 Pilot studies • Video recorded	Autumn 2016 Teacher Workshop 1 • Video recorded	Autumn 2016 Teacher Workshop 2 • Audio Recorded	Autumn 2016 Teacher Workshop 3 • Audio recorded
January 2017 Teacher workshops at the schools • Field notes	January/February 2017 Research lesson 1 • Video recorded	January/February 2017 Teacher-researcher meeting • Audio recorded	March/April 2017 Research Lesson 2 • Video recorded
March/April 2017 Teacher-Researcher meeting • Audio recorded	May/June 2017 Research Lesson 3 • Video recorded	May/June 2017 Interviews w/ teachers and students • Audio recorded	Autumn 2018 Talkwall feedback meeting w/ teachers • Field notes

During the spring semester, I participated in the collection of classroom video recordings and made observational field notes in three of the four schools in Norway. Additionally, I participated in data collection from student and teacher interviews at two different schools. I also participated in one teacher-researcher meeting between the lessons.

4.1.2 Empirical material and data selection for the three articles

Researchers using DBR methods often collect large data corpuses comprising video, audio, interviews and notes to understand ongoing processes. DBR methods require a lot of resources during data collection, and there is often not enough time to analyse the amount of

32

data that is collected. Data selection and data reduction can therefore be an issue in large projects such as DiDiAC. When selecting portions from a larger data corpus, the researcher could select those segments that best prove the researcher's point. One suggested solution to this issue is to make the data base and criteria for scoring available to the research field (Schoenfeld, 1992). Although not made available to the entire research field, the data collected for the DiDiAC project was discussed and reflected on by several researchers from different institutions, as I will explain. The issue of data selection will be further discussed, along with other methodological issues, in Section 4.4.2.

As described, a rich data corpus was collected for the DiDiAC project. In total, the study comprised 57 video-recorded lessons using two cameras. The setup of the cameras in the classrooms involved focusing one camera on the teacher and the teacher-Talkwall screen and focusing the other camera on a group of students. The student groups were randomly selected. To analyse the data corpus, the research team systematically approached the material and combined structured coding, descriptive statistics and qualitative methods (Ludvigsen et al., 2010; Major et al., in press). During this first phase of data analysis, all the researchers contributed to categorising and organising the video-recorded lessons. The video data was transcribed in original languages and coded minute-by-minute according to participation structures (whole-class, group and individual work) and interactivity and non-interactivity (Mortimer & Scott, 2003). The students' and teachers' Talkwall activity, such as creating, editing and pinning to the wall, was also included in an Excel spreadsheet (see Appendix 1). This first phase of initial coding was important in terms of gaining an overview of the collected video recordings. More importantly, the reflections and discussions with the research team were crucial for gaining a common understanding of how to interpret the participation structure in terms of interactive and non-interactive. Moreover, this initial categorisation provided an indication of how much Talkwall was used across the lessons.

The initial coding revealed differences between the lessons. Some lessons were clearly more interactive than others, and the use of Talkwall varied. One of the Norwegian teachers had a high level of interactivity and use of Talkwall. The minute-by-minute categorisation demonstrated many activity shifts. This discovery is what first encouraged me to investigate this teacher's lessons more deeply (Articles 2 and 3).

4.2 Methods used in the studies

All three articles in this thesis utilise data from the DBR project, and the overview in Table 1 shows the research questions, the analytical focus and the data types used in each study.

In all three articles, the primary source of data was video recordings of classroom interactions. The selection of video as the primary data source was driven by the level of detail enabled by video data. Having interactional data recorded also makes it possible to revisit the data several times and to discuss and explore the data with other researchers (Derry et al., 2010). Based on repeated viewings, I was able to investigate how the teachers and the students interacted and how they interacted with the resources, such as talk rules and the microblogging tool. The additional data – such as the Talkwall logs, the interviews, lesson plans and field notes – served as important contextualising data. These data informed my analysis of (1) how the teachers and the students developed their talk rules and (2) information about the planned design, as the enacted design was not always in sync with what was planned. Data collected from Talkwall also provided important information about, for example, what contributions the students talked about, as their iPads were not always visual in the video recordings.

The analysis in the three articles was conducted on multiple levels (e.g. systematic minute-by-minute coding, frequency counting, thematic analysis and interactional analysis). Articles 2 and 3 are qualitative case studies, meaning that I have conducted an empirical enquiry that investigates a phenomenon in an authentic context (Yin, 2018). There are myriad definitions of case studies, which makes the method flexible when considering design. For the current thesis, I define case study in line with Yin (2018), who considers the use of case studies an empirical method that investigates a contemporary phenomenon (the "case") in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident. Furthermore, as case studies intend to investigate phenomena in real-world contexts, other methodological characteristics become relevant as features of a case study because there will be many variables that may or may not rely on multiple sources of data (Yin, 2018).

Table 1

Overview of research questions, analytical focus and the data types used in the three studies

	Article 1	Article 2	Article 3
Research questions	RQ: What characterised the teacher's strategies to make talk rules relevant in the context of co-located microblogging activities and how did the strategies vary across classrooms?	RQ1: In what ways did the teacher make relevant for the students the purposes and practices of talk for learning during co-located microblogging activities? RQ2: What was the students' uptake of the practices of talk for	RQ 1: What characterises the teacher's educational design of an activity that uses a microblogging tool? RQ 2: How do students pick up on the teacher's educational design?

		learning during group interactions?	
Analytical focus	Teacher strategies	Teacher strategies and students' uptake	Educational design
Unit of analysis	Instances involving Talkwall and talk rules.	Interactions over time.	Interaction sequences, including Talkwall contributions.
Type of data	Video-recordings of the teachers' 57 lessons (Primary data). Class talk rules. Field notes. Student and teacher contributions to Talkwall. Teacher interviews.	Video-recordings of one teacher's lesson using two cameras, with one camera focusing on the teacher and one camera focusing on one group (Primary data). Student and teacher contributions to Talkwall. Class talk rules.	Video – recordings of three lessons from one teacher using two cameras, with one camera focusing on the teacher and one camera focusing on one group (Primary data). Student and teacher Talkwall contributions (Primary data). Audio-recorded teacher-researcher meeting. Class talk rules and lesson plans.

In the following sections, I will go into more detail about the three different studies. I will present the studies in the following order: Article 1, which includes the analysis of all the teachers, and Articles 2 and 3, comprised of the case studies.

4.2.1 Analysing 20 teachers and 57 lessons

As the initial overview encouraged me to investigate one teacher's three lessons more closely, my first steps were to repeatedly watch the video-recorded lessons as well as read the lesson plan, listen to the audio recordings from the teacher-researcher meeting and read the Talkwall contributions from the lessons. One thing that captured my attention was the teacher's various ways of making explicit the class talk rules to the students. As I started to systematically categorise her different approaches, I began wondering whether explicit focus on talk rules was something that all the teachers did, whether this was a unique approach, whether there were other ways of doing this, and of course, how and to what extent the students picked this up. Therefore, for the first study, I decided to systematically review all 57 lessons by repeatedly watching the video-recorded lessons as well as identifying the local talk rules. Hence, for Article 1, all the video-recorded lessons comprised the primary data. All 57 lessons included several activities, with the lessons typically combining plenary sessions, group work and individual work. Talkwall was used in most lessons, usually to report on group work in class, but Talkwall was also used for individual and homework purposes. Class talk rules, lesson plans, field notes, Talkwall data and recordings of teacher-researcher meetings were important secondary data used to analyse the classrooms as social practices and, moreover, to enable a

better understanding of the existing institutional cultures of the different schools and the individual teachers.

4.2.2 Zooming in on one teacher

For the second study, I chose to focus on the teacher whose strategies stood out from those of the other teachers. Among the several researchers observing and analysing the empirical material, there was agreement that this teacher stood out. Therefore, I decided to zoom in more closely to discover how one teacher made relevant for the students the purposes and practices of talk for learning during co-located microblogging activities. To do this, I went back to the three lessons and started to investigate her strategies in greater depth. I analysed this teacher's three lessons and selected one lesson to examine further. This lesson was selected for two reasons. First, the lesson was particularly rich with examples of the teacher's explicit work with talk rules in various ways, including the use of various tools. Second, several functionalities of Talkwall were used alternately throughout the course of the lesson for both whole-class and group interactions. For Article 2, the empirical material is therefore one lesson from the same teacher. As in the first study, class talk rules, lesson plans, field notes, Talkwall data and recordings of teacher-researcher meetings were important secondary data.

4.2.3 Talkwall and educational design

Based on the close analysis of one teacher's work to make relevant for the students the purposes and practices of talk for learning, conducted in Article 2, I started to wonder more about the role of Talkwall in this context. In all three lessons given by this teacher, Talkwall played an important role in the educational design. However, in one of the lessons, the teacher used Talkwall more extensively both regarding duration and various activities. I therefore zoomed in on the role of Talkwall in this particular lesson. This lesson differs from the one used as a case in Article 2. The primary empirical material comprising Article 3, as in the other studies, is video recordings. However, Talkwall activity (i.e. creating, editing, pinning to the wall and hash tagging) and how the students used Talkwall in their face-to-face interactions were also considered primary data. Important secondary data were recordings of teacher-researcher meetings, lesson plans, field notes and, naturally, the talk rules of the class.

4.3 Analytical procedures

The analysis for this thesis was conducted at different levels (see Table 1). As explained in Section 4.1, the research group collectively analysed the participation and lesson structure.

This was important for the selection of cases for my study. As the data in the three studies was analysed at different levels, I will account for the analytical procedures in the following section. Some of the analytical procedures were used in all three studies; here, they will be presented thematically.

4.3.1 Thematic analysis

The analysis for Article 1 began with participation and structure analyses, and I continued the process of 'immersion' in the data by viewing and re-viewing all 57 video-recorded lessons to gain an overview and become familiar with the dataset. This was an inductive approach, which I used to investigate all the collected material with a broad question in mind about the talk rules. Then, I gradually began to perform a closer investigation (Derry et al., 2010).

My primary source of empirical material was the recordings from the camera, focusing on the teacher. In these recordings, the teacher has a microphone that provides high-quality audio. As the video recordings were transcribed, I used these transcripts to support my viewing. In cases where the audio quality was poor or the camera out of focus, I used the second camera to obtain data from the whole lesson. During this process, I started to notice things of interest, which I recorded in a separate document. The amount of video, transcripts and an increasing number of notes required a systematic organisation of the empirical material. Therefore, I imported the transcripts to the software NVivo 12. I also imported the lesson plans, field notes, class talk rules and my initial notes. The video recordings were not imported to NVivo because of the poor video-viewing option in the software. I therefore watched the video in a separate computer window alongside the transcripts in NVivo.

The systematic coding began with identifying 'instances' of the phenomena in which I was interested, namely, what characterised the teachers' work to make talk rules relevant in the context of co-located microblogging activities. I thus needed to use the locally developed talk rules for each class as a basis for identifying where the teachers focused on the talk rules. What counted as an instance were (1) a Talkwall activity included in the lesson; (2) the teacher's inclusion of some form of explicit reference to the local class talk rules, either orally or written (analogue/digital); and/or (3) the teacher's prompt via a question, activity or tool related to the talk rules in the classroom. The instance began when the teacher initiated one of the above and ended when a new topic or activity was initiated. These identified instances were marked in the transcripts by using the node function in NVivo. This process was open and iterative.

When the instances were identified, I started to thematically code them. These initial themes were open and described the teachers' various strategies. By coding the empirical material in this way, we simplified actual classroom interactions. For example, in the classroom, both written and oral interactions appeared simultaneously, and teachers typically used more than one strategy at the same time; thus, separate themes were constructed. The process was complicated for several reasons. Inductive coding requires several iterations to establish a reasonable set of themes. Initially, my coding was intended to contain only what the teachers said during their lessons. During the inductive process, I observed that several teachers used a variety of tools in addition to their oral instructions. I thus conducted the coding process one more time to include these tools. Because these were only visual in the videos and were not always accounted for in the transcripts, I had to use the memo tool in NVivo to complement the transcripts.

The themes evolved throughout the coding process, and many of the initial themes were split, renamed or combined with other themes through an iterative process (Braun & Clarke, 2013). The themes were also discussed with the co-authors several times during the analytical procedure. During the process of analysis, the themes were organised and built into larger themes consisting of smaller units with similar characteristics (Braun & Clarke, 2006, 2013). With the co-authors, I revisited the empirical material several times, discussing and adjusting the construction of these themes. Uncertain cases were discussed further until agreement was reached. In this way, we achieved a reasonable understanding of the empirical data.

The thematic analysis resulted in five themes characterising methods and techniques the teachers used to make talk rules into relevant resources for developing students' talk for learning: (1) displaying, (2) reminding, (3) inviting, (4) metatalk, (5) integrating. The analysis also identified variations between the teachers. With the variation in mind, I discussed different approaches for addressing variation in the study. Although thematic analysis does not usually provide a quantified measure (Braun & Clarke, 2006), we decided to create a way to calculate the mean frequency of instances and variation by counting the number of instances within each theme for all teachers within all lessons. Since the lessons varied in length (from 60 min to 120 min), we divided the number of instances within each theme by the total lesson time in minutes to compare across lessons. This calculation of the mean frequency provides a useful supplement to the thematic analysis to discuss variation in a systematic way across a data set. By embedding this concurrent strategy in our analysis, a secondary method of analysing the data, we added a different level of analysis, and the description of the teachers' strategies became richer

(Creswell, 2009). This calculation was, however, not an attempt to create an accurate measure, but rather employed as a useful method to discuss variation across the teachers.

4.3.2 Reflections on using computer programmes for thematic analysis

Using computer tools to analyse qualitative data has strengths and weaknesses. For my analytical approach, they were necessary tools for systematically coding the empirical material. This procedure could, of course, be conducted manually; however, it would be difficult to keep things organised and to move back and forth in the data material during the construction of themes, for example. Still, I have considered some risks during this process. The most crucial and complicated issue was focusing on quantity, which contained the risk of thinking, for example, that an increased frequency of the teacher's strategies to activate the talk rules was meaningful. However, I think the solution that we landed on does not consider quantity a meaningful measure. We only consider variations an interesting phenomenon. Another challenge was the risk of usability frustration and the time spent learning how to use this software. Although I experienced some frustration and challenges with NVivo, I do think it will be a useful competency in future research projects.

4.3.3 Analysis of the interactions

In Article 2 and 3, I analysed the data on an interactional level. This allowed me to investigate the interweaving of talk, actions and resources and to describe participants' practices in detail. Limiting the selection of video material to one teacher enabled me to describe and conduct a qualitative analysis of the interactions, which has been emphasised as a valuable strategy (Arnseth & Krange, 2016), particularly for analysing technology-mediated classroom contexts (Furberg, 2016). Previous researchers have also recommended using video to investigate in detail moment-to-moment interactions and to ascertain how tools are utilised (Derry et al., 2010).

In Article 2, one lesson was analysed on the trajectory level and on the interactional level. These two levels of analysis were used to inform each other (Rasmussen, 2012). Here, the video recordings were a key medium for capturing complexity in the interactions (Derry et al., 2010). The analytical process was conducted using procedures employed in previous studies on interaction (e.g. de Sousa & Rasmussen, 2019; Mercer, 2008; Twiner et al., 2021), and I repeatedly watched video recordings of both the whole-class and the group interactions (Derry et al., 2010). In Article 2, I used the concept of participation trajectory to trace the interactional work over periods of time and to specify the teacher's and the students' interactions and their

use of the available tools. In Article 2, I used scaffolding as an analytical concept to inform the analysis by employing the following scaffolding properties: (1) channelling and focusing and (2) modelling (Pea, 2004; Wood et al., 1976).

To analyse the interdependency between interactional achievements and tools, uptake was used to refer to what the students derived from the teachers' strategies to make relevant for the students the purposes and practices of talk for learning and how the students applied these strategies in the context of co-located microblogging. As with Article 2, Article 3 addressed the sequential nature of the learning process (Rasmussen, 2012), emphasised learners' interactions across situations, and involved the trajectory level and the interactional level, which informed each other. In Article 3, the trajectory level characterises the teacher's design of the learning activity and was used to structure the lesson into sequences. Inspired by thematic analysis (Braun & Clarke, 2006), I analysed the teacher's planned and enacted activities, including how she embedded Talkwall in the educational design. For this study, I used video recordings. To determine the role of Talkwall, the logs from Talkwall were integrated into the transcript. I also used the video recordings with the transcripts to provide detailed information about other resources. In the next section, I explain this process.

4.3.4 Analysing and presenting data with multiple modalities

Article 2 and 3 focused on one teacher's strategies make relevant for the students the purposes and practices of talk for learning, including how the students picked up these strategies in their group talks. One central aspect was the role of multiple resources, which were activated. In the analysis, it was therefore essential to include the use of multiple modalities and how the participants related to these multiple modalities. Using video recordings along with the Talkwall transcript allowed us to closely analyse the multiple modes included in the interactions. The interactions in Talkwall, gestures (i.e. pointing to the screen), and other resources that were used (i.e. sentence openers) were included in our analysis. This allowed for an analysis of the interactions. For example, by including stills from the video in transcripts, I was able to illustrate key features of the context, particularly important information that would have otherwise been difficult to describe (Kershner et al., 2020).

Presenting the results yielded by an analysis of interactions that includes multimodal resources may have some challenges such as providing sufficient information about the context. How the findings were produced is also an issue of transparency. This challenge implies the need to provide sufficient descriptions of the research process and the use of analytical tools. My method of demonstrating this analytical process in Article 2 and 3 provides both transcripts,

adapted from the highly acknowledged 'Jefferson system' (Jefferson, 1984), along with stills taken from the video recordings. The selection of excerpts presented in the articles thus depict how both the oral and material tools are activated and what this 'looks like' in the classroom context. The images presented are modified versions of stills from the video recordings and Talkwall. By modifying the images, I was able to illustrate realistic classroom settings while still considering strict regulations regarding the anonymisation of data. I believe that this form of representing the findings provides clarity.

4.4 Research credibility

The nature of qualitative research makes it challenging to agree on universal criteria for judgements regarding research credibility. Still, there are ways to evaluate whether qualitative research can be regarded as more or less credible by carefully considering guidelines that ensure reliability and validity. This is important to ensure that research is conducted and reported in an ethical manner. Research should contribute creating new knowledge, thus requiring a high standard of integrity and ethical responsibility in all phases of the process. Research conducted in an irresponsible or unethical manner can have serious consequences and weaken the credibility of the research. My role as a researcher thus entails a responsibility to both carry out and disseminate the research with a high standard. According to Maxwell (2013), research ethics are an important part of the entire research design. Research ethics is also relevant to the choices of method, objectives, theoretical framework and research questions and concern the validity and reliability of the research. These parts of the research design are not detached from each other but are mutually influenced by one another throughout the research process and by ethical considerations.

In the next section, I will account for the measures that I have taken to ensure research credibility for this qualitative study.

4.4.1 Ethical considerations

Respect for human dignity and personal integrity can in no way be neglected to gain insight into research. Individual concerns must be taken care of at all times, according to legislation and ethical guidelines. As my study involved participants informing my research, it was important to familiarise myself with and follow the rules that apply to human dignity, privacy, information and consent per The National Research Ethics Committee for Social Sciences and Humanities (NESH, 2021). As with all Norwegian research projects, the DiDiAC project has been approved by and followed the guidelines provided by the Norwegian Centre

for Research Data (NSD). By following these guidelines, the data about participants in this project has been collected, stored and shared legally and safely in line with the strict regulations for general data protection (GDPR).

Of crucial concern is protecting personal integrity, safeguarding the interests of individuals and ensuring that the research takes place in accordance with basic privacy considerations. It is nevertheless the case that individual autonomy and integrity have no absolute definition but will vary, depending on contextual conditions and different frames of reference (Silverman, 2017). In the DiDiAC project, all the participants voluntarily gave written consent, without pressure or persuasion, in line with NSD regulations. Since the research involved children, their parents were informed and gave their consent. For the same reason, to provide sufficient information about the research, the information was made comprehensible to the recipients and linguistically adapted to ensure that the information was actually understood by the students. The students were also orally informed about the project and about the strict requirements for storing and processing the data material in advance of each video observation and interview. Several measures were conducted to prevent someone from feeling uncomfortable. For example, we had ongoing communication with all participants, the participants were included in discussions with the research team during the work with data collection, and we made sure to provide the participants with information and establish a good relationship with the participants.

However, it was difficult to ensure that all participants felt comfortable with being video recorded at all times. For instance, having video cameras in the classroom might have been stressful for both teachers and students, making it challenging for them to stay focused on the task at hand. To make the situation a bit more comfortable, we visited all classrooms before the actual video recordings, showing the participants the camera and audio equipment and informing them about the project. Hopefully, this made the situation less stressful and ensured that participation was still voluntary when we started recording. The participants were also informed about their right to withdraw from the project at any time during each visit from the researchers. This hopefully contributed to creating a safe and trusting environment for the informants.

Surely, conducting video research in classrooms raises ethical concerns regarding the protection of privacy. To ensure the protection of privacy, all video recordings were stored on secure servers provided by University of Oslo and University of Cambridge. Access to the video files has been restricted to the researchers and research assistants participating in the projects. The names of schools and individual teachers and students have been anonymised in the

materials that are published and presented. As mentioned earlier, the video stills are presented as drawings, which makes it difficult to identify the participant or the school.

4.4.2 Reliability

Considered broadly, reliability refers to the possibility of achieving the same results if the same procedures of a study are conducted by another researcher with another group of participants (Silverman, 2020). For quantitative research, this usually occurs by using tools and measurements that yield the same results with repeated trials. However, for qualitative research, the exact replicability of both the processes and the results is more challenging. Therefore, reliability for qualitative research lies in consistency. The research process should be made transparent by describing the research strategies and methods and by making explicit the theoretical stance (Silverman, 2017).

In this study, I took several measures to be consistent and transparent about the processes of collecting and analysing data. I have also provided a rationale for the theoretical perspectives that I used to analyse and interpret the empirical material.

The data collection was conducted by several researchers, and we collected data from two different countries using the same research design. Using video data has advantages for providing reliability. For example, I have had the opportunity to review the recordings several times. In addition, I have watched the recordings with other researchers from the DiDiAC team. Moreover, applying stills from both the video recordings and Talkwall logs to the transcripts enabled me to investigate selected parts of the different materials in detail. For example, in Article 3, I focus on selections where the students were engaged in interactions using Talkwall.

In summary, I consider the reliability of my study to be strengthened by my effort to describe the data collection procedure, the thematic analysis, the analysis of the interactions and the choices that I have made along the way. The reader can therefore judge whether the findings from this study can be applied to other contexts (Silverman, 2017).

4.4.3 Validity and generalisability

In qualitative research, validity is the extent to which the tools, processes and data accurately represent the phenomenon that it refers to (Braun & Clarke, 2013; Leung, 2015). This means whether the claims made about the data and the methods used to make the claims are plausible.

One potential threat to validity is researcher bias in the process of selecting data sets and extracts from a larger corpus, for example, to claim that a particular phenomenon is typical,

rare or frequent in the studied population (Maxwell, 2013). The threat of researcher bias has been criticised, especially in DBR studies, because it can arguably be difficult for a researcher to stay trustworthy and unbiased while simultaneously being involved with the teachers in the design and intervention of the study, interpreting the quality and writing up the results (Dede, 2005). To avoid this threat to validity, the data for this study was collected from multiple classrooms over a longer period of time. This study also includes data about the participants from before and during their work with Talkwall and Thinking Together and the interview following the research lessons. Additionally, I have used interviews, Talkwall contributions, documents from planned activities and teacher-researcher meetings. Triangulation by combining different methods and analyses, as presented in Table 1, enabled me to see whether they corroborated with one another (Silverman, 2017). Although I did not analyse all the collected data as closely as I did with the video recordings, they did give me a broad picture of what was going on. In Article 1, we provided a form of 'quasi-statistics' (Becker, 1970 in Maxwell, 2013) by simply counting the number of the instances of the phenomena to determine what strategies were used more than other strategies and to numerically illustrate the frequency and wide-ranging variation across classrooms, which our findings indicated (Silverman, 2017).

To represent video data is challenging and might even affect the validity of the study, as the reader needs access to at least fragments of the data to make judgements about the findings. Giving the reader access to all the video data is unlikely due to ethical restrictions. In my studies, I tell the reader what happens in the recordings and how we have analysed these happenings by providing modified images that are representative examples. Thus, I have tried to provide evidence of our findings in an understandable way so that the readers can assess and evaluate the findings.

A large collection of data can still threaten validity because, when reducing this data to a manageable amount, it is possible that portions of the data are selected to illustrate, for example, a theoretical point. One suggestion for avoiding this validity threat is to make all the collected data publicly available to the research field. This was not possible for my data, of course, given the privacy restrictions. However, ongoing discussions with fellow researchers and supervisors, as well as co-authoring the articles, have helped me avoid this threat to validity.

Another approach that I have taken to ensure validity is to use the teacher-researcher meetings between the video-recorded lessons as 'member-checks' (Braun & Clarke, 2013; Maxwell, 2013) or respondent validations (Silverman, 2017), because these meetings enabled feedback from the teachers about their conclusions from their own viewing of the video-recorded lessons. However, this was not systematically operationalised in Article 1. For Articles

2 and 3, the teacher was consulted several times during the project about the results of our investigations.

Previous knowledge based on experience can also threaten the validity of the research. During the project, I have therefore been critical of my own assumptions and values and strived to be transparent, discussing with fellow researchers how my own views might have affected the investigation (Maxwell, 2013).

Another threat to validity stems from the influence of the researchers in the classroom where the studies were conducted (Maxwell, 2013). All the researchers who collected data for the DiDiAC project took several measures to reduce the effects of their presence and the effects of video cameras in the classrooms. The students were informed in advance about the project and the cameras that we used, as well as how we were going to use the recordings afterwards. The cameras were placed at the back of the classrooms so that they would not disturb the teaching. We also discussed with the teachers how to best set up the cameras and whether there were students who could potentially be distracted or feel uncomfortable. By taking these measures, I believe that we reduced some of the stress related to having cameras in the classroom, which helped the participants quickly acclimate to the setting. This was confirmed in the feedback from the teacher-researcher meetings, where the teachers reported some camera and observer effects, primarily in the first lesson.

As I have explained above, I argue that the measures taken in the current study ensure validity, especially ecological validity, concerning the relationship between the studied phenomenon in the real world and the phenomenon in the setting where it was studied (Schmuckler, 2001). However, since the setting in the current study involves an intervention, it might be argued that the intervention leads to certain problems in terms of ecological validity (Braun & Clarke, 2006). Performing a design-based study means that we conducted an intervention with the teachers, providing them with tools and resources. Although this study involved an intervention in the classroom environment I believe that problems in terms of ecological validity have been prevented because we only enhanced the phenomenon that was studied and not necessarily changed anything else.

Ecological validity is important for the generalisability of my findings (Bryman, 2012; Silverman, 2017). Generalisability refers to 'extending research results, conclusions, or other accounts that are based on a study of particular individuals, settings, times, or institutions to other individuals, settings, times, or institutions than those directly studied' (Maxwell, 2013, p. 135). In other words, whether the results generated from my study can be applied to a wider or different population, such as other students and teachers in classrooms and with different types

of technologies (Braun & Clarke, 2013). Sociocultural research emphasises the uniqueness of the contexts studied and, therefore, the challenge of generalisation. However, versions of generalisability might capture the wider relevance of the results from the type of study that I report on, indicating that the findings could guide other situations or apply to situations beyond the original case study, based on the relevance of similar theoretical concepts or principles (Yin, 2018). This version of generalisability is often referred to as analytic generalisation and is closely related to ecological validity. An analytical generalisation involves making a reasonable judgement about how my study can shed empirical light on some theoretical concepts or principles. In my study, this is possible because I have provided rich contextual descriptions of the research design, the microblogging technology, the pedagogical approach, the process of the research project and the analytical procedures that have been conducted so that the reader can follow in my footsteps. Moreover, I have described the theoretical framework that guided the analysis and presented previous research related to classroom talk and the role of technology. In Chapter 6, I discuss my findings in relation to the previous research and thereby contribute to wider knowledge about classroom talk for learning and the use of technology (Braun & Clarke, 2013; Yin, 2018).

5 Summary of the articles

5.1 Article 1

How teachers make talk rules relevant as collective scaffolds in the context of digital technology - support for and from microblogging (Amundrud, Rasmussen & Warwick)

This study focuses on the characterises of the work teachers do to make relevant the situated rules for talk for their students when they engage in collaborative classroom talk in combination with co-located microblogging. All video recordings from the participating teachers' lessons, 57 lessons in total, were analysed to answer the following research question: What characterised the teachers' strategies to make talk rules relevant in the context of co-located microblogging activities, and how did the strategies vary across classrooms? In addition to the video recordings, we used the class talk rules, field notes, Talkwall contributions and interviews of the teachers to answer our research question. Through a thematic analysis, we constructed five distinct categories that describe the characteristics of how the teachers made the talk rules relevant as scaffolds for their students' collaborative talk while using the microblogging tool. The five categories – (1) displaying, (2) reminding, (3) inviting, (4) metatalk and (5) integrating – represent strategies that teachers can use to support students in

developing their talk for learning skills. The study also focuses on how the use of co-located microblogging may change classroom interactions, and we discuss how such changes can provide opportunities for students and teachers to reconsider how to talk together in order to learn. We used the concept of scaffolding to investigate the teachers' role in making the talk rules relevant, and we argued that talk rules can potentially function as collectively created scaffolds.

In addition to the five characteristic strategies, our results from the analyses show that although all teachers managed to use the talk rules, there was a great deal of variation in the teachers' repertoire to make the talk rules relevant as scaffolds for students. Moreover, we found that in some classrooms, co-located microblogging activities seemed to make the teachers more aware of the need to explicitly structure group discussions so that they aligned with the collaboratively established talk rules. The co-located microblogging activities also seemed to trigger teachers to invite individuals or groups of students to build on, elaborate, evaluate, challenge and explicitly invite reasoning or clarification about their own or another's oral or Talkwall contributions.

In this study, we also found that the co-located microblogging tool created a new format of complementary oral and written talk, which included an open and public space where students' short contributions were displayed. We suggested that this new format oriented the teachers and students towards engaging in metatalk about participation in talk for learning.

The results also show how teachers integrated work with talk rules in the lesson activities, how they focused on specific talk objectives, and how they provided the students with a clear structure for the group talk when using the microblogging tool. Here, the teachers used written or oral questions, key phrases, or sentence openers, and/or assigned roles to their students. This way of using talk rules to scaffold the students' talk can provide a clear structure, ensuring that the students use more exploratory talk in their group discussions.

We conclude that the combination of explicit focus on talk rules in the context of co-located microblogging can assist with interactional work that teachers need to support students' engagement in talk for learning. However, microblogging technologies require teachers to carefully plan and enact the necessary pedagogical strategies and ensure that talk rules function as collective scaffolds.

5.2 Article 2

Teaching talk for learning during co-located microblogging activities (Amundrud, Rasmussen & Warwick, 2022)

This study focuses on ways in which a teacher manages to establish the dialogic classroom ethos that is needed to engage students in talk for learning when using the microblogging tool Talkwall. In contrast to Article 1, in which we analysed all 20 teachers, we selected one teacher from our data corpus for closer analysis in Article 2. We also focused our analytical attention on one particular lesson. The empirical material used in this study is comprised of video recordings of one teacher's lesson using two cameras, with one camera focusing on the teacher and one camera focusing on one group of students. In addition, the students' and teacher's contributions to Talkwall and the class talk rules were used to provide some context. In this study, we address two research questions: (1) In what ways did the teacher make relevant for the students the purposes and practices of talk for learning during co-located microblogging activities? And (2) What was the students' uptake of the practices of talk for learning during group interactions? The analytical focus is on how the teacher make the purposes and practices of talk for learning relevant for the students, using a range of resources to make talk rules a part of the fabric of classroom interactions during Talkwall activities. As part of the analysis, we also examined the students' uptake of the practices appropriate to talk for learning in the peer group interactions as they use Talkwall. In the results of this study, we include modified images to illustrate the excerpts in realistic settings while following the relevant anonymisation regulations.

The results of the analysis from this study demonstrate how the teacher used Talkwall, together with other resources during the lesson, to scaffold students' talk for learning. The teacher made explicit for the students the purposes and practices of talk for learning and maintained the relevance of the talk rules throughout the lesson by (1) displaying representations of productive ways of talking together, (2) explicitly reminding students about the rules in the activity, (3) inviting all students to contribute, (4) integrating the talk rules into the learning activity and (5) encouraging meta reflection on the group interaction. By activating the shared class resources, such as class talk rules and sentence openers, she was scaffolding the students' talk by focusing the students on a specific way of talking together to learn. The teachers also modelled specific talk patterns by using sentence openers.

The students' uptake of the practices of talk for learning is seen, for instance, when they applied the sentence openers while simultaneously talking together in their groups and using Talkwall, and when the students engaged with their peers' contributions through both face-to-

face verbal interactions and microblog contributions. Access to their classmates' contributions in Talkwall allowed more perspectives and ideas to be shared during their interactions. This shows how the Talkwall activity enabled a wider discussion that extended beyond the group talks, with more voices being included than that which would be possible within a small group. Together, our results show how implementing a microblogging technology such as Talkwall in a co-located manner provides a new setting in which ideas can be contributed and becomes a collective scaffold for talk for learning when mediating the student's contributions.

5.3 Article 3

#Fact or #opinion: The educational design of a microblogging activity intended to engage students in productive interactions (Amundrud, Smørdal & Rasmussen, 2021)

In the third study, the role of microblogging technology is considered in relation to the educational design of an activity using this technology in a co-located manner. We studied one teacher's educational design, which used microblogging to explore distinctions between facts and opinions. We also considered how the students picked up on this educational design. In this study, we used two-camera video recordings from one teacher's lessons as our primary data. In addition, we analysed the students' and the teacher's Talkwall contributions and used data from the audio-recorded teacher-researcher meeting, the class talk rules and the lesson plan to provide information about the educational design.

The findings from this study show how an educational design involving co-located microblogging can provide new possibilities for facilitating peer interactions by systematically enabling students to access more of their peers' ideas, produce and discuss collective ideas, and participate in exploratory talk. In particular, this study demonstrates how the creative use of hashtags can potentially provide a suitable mechanism for facilitating peer interactions that promote critical thinking. The Talkwall functionalities – contributions, the feed, the wall, the space for the teacher and the hashtags, called bridging concepts (Smørdal et al., 2021) – were key elements of the educational design. The bridging concepts enabled the students to explore the distinction between facts and opinions and promoted exploratory talk. Supported by our empirical investigation, we suggest that educational activities using co-located microblogging can be designed to engage students in activities known to foster critical thinking skills. We also demonstrate that the students practised several skills that are known to be educationally productive for learning, including asking questions, giving reasons, providing evidence and elaborating on others' ideas in activities that were enabled by digital technology.

6 Discussion and contributions

In this final chapter, I will bring together the findings from the three articles and discuss their contributions to the existing research on classroom talk and digital technology. I will also address the theoretical and methodological contributions of the thesis before I discuss the possible implications of the findings and future research.

6.1 Empirical contributions

6.1.1 Developing a dialogic classroom ethos with digital technology

Earlier studies have demonstrated how teachers should focus on developing a classroom ethos that encourages students to talk together in ways that they learn from (Alexander, 2020; Clark et al., 2003; Mercer et al., 1999; Michaels et al., 2016). The collective development of talk rules can be a useful way of establishing a dialogic classroom ethos; however, this requires that the teachers work to make the talk rules relevant for the students in the activities (Warwick et al., 2013; 2020). Creating talk rules with the students does not mean that the students will start to follow them. The students need guidance and advice. Previous research on how explicit focus on talk rules can enhance students' talk for learning has found that talk rules should align with the educational context. For instance, the use of new technology might require careful consideration of the talk rules (Staarman, 2009). This thesis demonstrates how teachers can integrate an explicit focus on talk rules during microblogging activities and how the microblogging technology can actually support the teacher in guiding and advising the students to start following the talk rules when they talk together (Articles 1 and 2). This is in line with other studies on the teaching of talk for learning in the context of, for example, IWBs (e.g. Hennessy, 2011; Kerawalla et al., 2013; Kershner et al., 2010; Warwick et al., 2010). The current study corroborates the importance of the interconnected relationship between digital technology and pedagogy, meaning that the pedagogy can support the technology as well as the other way around in developing a classroom ethos that enhances students' talk for learning (Hennessy, 2011; Hennessy et al., 2018; Mercier et al., 2015; Staarman, 2009; Warwick et al., 2013).

6.1.2 Teachers' strategies and variation

Previous research implies that the development of and focus on talk rules is a successful approach for teaching and supporting students' engagement in talk for learning (Clark et al., 2003; Mercer et al., 1999; Michaels et al., 2016). The findings from this thesis add to the

existing research by demonstrating the characteristics of teachers' methods and techniques for making relevant to the students the purposes and practices of talk for learning in the context of microblogging (Articles 1 and 2). The analysis of the empirical data shows that teachers make talk rules relevant in a variety of ways: displaying, reminding, inviting, metatalk and integrating (Article 1). As demonstrated in both Article 1 and 2, these strategies can potentially make the talk rules relevant as collective scaffolds during microblogging activities.

The findings from previous research indicate that teachers' explicit focus on how students engage in talk for learning is rarely found in classrooms (Howe et al., 2019). The current study demonstrates that most of the participating teachers in the DiDiAC project focused on talk rules to make relevant for the students the purposes and practices of talk for learning during the observed lessons. This was, of course, expected since the development of talk rules was part of the intervention. However, there was considerable variation between the teachers (Article 1). While some of the teachers only worked superficially with the talk rules, for instance, by plastering posters to the classroom wall and reminding students about these a few times (Article 1), some teachers integrated talk rules into their lesson design (Articles 2 and 3). The fact that our results showed so much variation in teachers' explicit focus on teaching students how to talk together to learn may indicate that this is demanding work for teachers even though they have resources available. This work takes time to do and must be made a priority. Additionally, explicit work with classroom talk competes with other important educational goals. Another explanation could, of course, be that we as researchers are not communicating the importance of teaching talk for learning and the useful strategies for doing so well enough to the teachers.

6.1.3 Access to more perspectives and multiple ways to take part

Previous research has found that teachers' use of specific approaches or models to teach students how to engage in talk for learning can be successful (Clark et al., 2003; Mercer et al., 1999; Michaels et al., 2016). In all three studies, the teachers used resources from the Thinking Together approach in combination with the microblogging tool Talkwall. On its own and combined with the use of IWBs, the Thinking Together approach has been found to support students' development of talk for learning (e.g., Hennessy, 2011; Mercer & Littleton, 2007; Warwick et al., 2013). My thesis supports this finding and also adds to the existing research by showing how microblogging can potentially enhance students' participation in talk for learning.

In line with other studies of technologies and classroom talk for learning, my study demonstrates that microblogging can provide a shared dynamic dialogic space where the

students and the teacher explore ideas and develop a collective understanding (Gao et al., 2012; Hennessy, 2011; Kershner et al., 2010; Ludvigsen et al., 2019; Wegerif, 2007). The two mediational means in the microblogging tool Talkwall, the feed and the wall, can be used to assist the students' classroom talk and collective understanding as well as provide access to other students' ideas, as discussed in Articles 2 and 3. I will discuss mediational means in microblogging further in Section 6.2, which considers the theoretical contribution of the thesis.

Similar to an IWB, the microblogging tool Talkwall can provide the students with a shared dialogic space. Compared to the findings in the IWB studies, the students' ideas that were contributed to Talkwall can be distributed more evenly across the classroom. Additionally, since the ideas are distributed among all participants in the classroom, microblogging allows for more ideas and perspectives to enter the dialogic space (Articles 2 and 3). As demonstrated in Article 3, the students discussed ideas beyond their small group because ideas from other groups entered their Talkwall feed.

The use of technology can potentially promote new types of classroom interaction. For example, studies have suggested that a peer discussion activity around a computer before the students respond to a teacher-initiated question can disrupt the typical IRF structure. In other words, a discussion phase between the teacher initiation and the students' response (IDRF) where students sit back from the computer and engage in peer talk (Littleton & Mercer, 2013; Wegerif, 1996, 2007). Such a disruption in the structure can open opportunities for the technology to function as scaffolds for students' interthinking. In the current study, the microblogging tool can potentially provide a similar structural change when the students are encouraged to discuss their answers in groups before contributing their microblogs (Articles 2 and 3).

Also, using microblogging in combination with a specific focus on talk for learning allows students to contribute their answers to the whole class without being interrupted and waiting for their turn. This gives students time to think through their answers and contribute more equally than they do in face-to-face interactions only (Gao et al., 2012; Luo & Gao, 2012). Here, the current study aligns with Frøytlog and Rasmussen (2020), who find that the use of microblogging can give more students the opportunity to participate in whole-class talk and increase their opportunities to think and learn together.

My study also suggests that the microblogging tool can provide new opportunities for students to think together as the tool visualises the students' contributions and provides a form of materialisation of students' interthinking (Littleton & Mercer, 2013). This is demonstrated in the studies when the students bring other students' ideas from the Talkwall feed into their own

discussions (Articles 2 and 3). This is possible when students discuss their ideas in groups. When engaging with the microblogging tool, the students gain access to other groups' ideas, which are displayed spatially on a screen through the microblogs.

The microblogging tool also gave the teacher unique access to the students' talk as the students' exploration of ideas became visible though the microblogging (Article 2). Moreover, both the teacher and the students can lift the small-group discussions beyond the small group and distribute them across the groups as well as to the whole-class discussion (Mercier et al., 2015; Rasmussen & Hagen, 2015; Rasmussen & Rødnes, 2020). By having access to the students' emerging ideas through the technology, the teachers can provide more contingent scaffolds for students' talk (Articles 2 and 3).

6.1.4 Materialisation and semi-permanence for classroom talk

The meeting between technology and an explicit focus on talk for learning creates new possibilities for participation due to the partial material nature of the language resources. When engaging in exploratory talk for learning, participants explore unfinished ideas together. The type of talk that students learn from is often tentative and hypothetical (Barnes & Todd, 1976). Therefore, presenting and distributing ideas in this exploratory form can be challenging. The short format of microblogging may support the distribution of unfinished ideas. Thus, when contributing ideas to the microblogging tool, the microblogs can be thought of as digitally improvable objects (Twiner et al., 2010) rather than finished pieces of work. Microblogging can thus provide a way to draft ideas at this stage, where the ideas are in between the fluidity of talk and the more permanent form of written texts (Littleton & Mercer, 2013). In microblogging activities, the students can safely try out ideas by contributing them to the wall; hence, emerging thoughts also have a form of semi-permanence and may be referred to later and also inspire other students' thinking (Article 3). Moreover, the type of semi-permanence to oral language provided by microblogging activities seems to create a bridge between talk and writing, for instance, making shifts between group talk and whole-class talk more straightforward (Articles 2 and 3). In these situations, the teachers can bring the ideas from the students' group microblogs, look through the ideas and build on these in the whole-class situation. In this way, the teacher can both gain an overview of the students' collective thinking and lift their ideas forward in the whole class (Articles 2 and 3). In other studies, it has been argued that bringing students' ideas from Talkwall into whole-class discussions even increases the agency of the students because this slightly informal format encourages students to try out their ideas (Omland & Rødnes, 2020).

Microblogging can provide more ideas, perspectives and alternatives to exploration (e.g. Frøytlog & Rasmussen, 2020; Ludvigsen et al., 2019; Mercier et al., 2015; Omland, 2021). However, for sharing more exploratory ideas, it is important that the classroom ethos allows for and encourages unfinished and emergent ideas. For this to occur, the educational design should explicitly focus on the written blogs as exploratory and not as final drafts or presentational speech (Barnes & Todd, 1976), even if they are presented publicly. Thus, it is of course important to have an explicit focus on resources that support a dialogic classroom ethos, such as talk rules (Articles 2 and 3).

6.1.5 Summary of the empirical findings

In summary, the empirical findings from the three studies show that using co-located microblogging with a pedagogical approach designed to enhance classroom talk can:

- assist the interactional work needed for teachers to support students' engagement in talk for learning,
- lead to teachers and students' awareness of talk for learning,
- support teachers in structuring activities and lessons and thus provide collective scaffolds for students' engagement in talk for learning,
- promote new forms of classroom collaboration,
- provide a new multimodal context for students' ideas to be discussed, thus allowing an increased number of perspectives and more students to participate in the discussion,
- allow for students' unfished ideas to be explored and elaborated on by multiple participants and thus provide a way of visualising interthinking,
- provide an aspect of permanence to classroom talk that is beneficial for the work with developing students' oracy skills and
- create new possibilities for teachers to take advantage of digital technology to work explicitly with the development of students' oracy skills.

6.2 Theoretical contributions

In this thesis, I describe how teachers' educational design can use resources such as talk rules to provide collective scaffolding for students to engage in talk for learning in the context of microblogging activities. Scaffolding has been extensively discussed in the context of classroom talk and collaboration (e.g. Arnseth & Krange, 2016; Fernández et al., 2002; Mercer, 2002; van de Pol et al., 2010; Warwick et al., 2010). I believe that scaffolding provides a useful concept that helps unpack how teachers and tools can, in various ways, enable student's

engagement in talk for learning when digital technology is being used. In the following, I will elaborate on this contribution.

The teacher's role in scaffolding can be considered a process of managing the affordances and constraints of the available tools to support students' learning (van de Pol et al., 2010). This thesis demonstrates the pedagogical strategies teachers use to make talk rules relevant in microblogging activities to scaffold students' engagement in talk for learning (Articles 1 and 2). For example, when teachers integrated talk rules in specific microblogging activities, the students were provided with a clear structure, ensuring that they used more talk that was beneficial for subject learning in their group discussions (Articles 2 and 3). In these instances, the talk rules functioned as collective scaffolds in the microblogging context that enabled the students' engagement in talk for learning, even without the presence of the teacher. This is in line with what previous research has referred to as indirect scaffolding with technology (Warwick et al., 2010). Adding to previous studies that point to a re-conceptualisation of scaffolding (Fernández et al., 2002), this study also shows how students engaging in peer talk can use the microblogging tool to access ideas and perspectives from students across the classroom. In this way, the students are provided with a broader form of collective scaffolding in their peer group enabled by the microblogs that contain the joint collection of ideas from all the peer groups in the class.

Scaffolding can take place on a group level, and the teachers' educational design of an activity, meaning the structure and the sequencing of the subject curriculum, can scaffold the students' learning (Cazden, 2001). In my thesis, I contribute to developing the scaffolding concept by specifying how teachers can provide collective scaffolds for their students' talk for learning by making talk rules relevant in microblogging activities and by structuring the lesson activities using the microblogging technology. In this thesis, one characteristic of the teachers' educational practice was that the microblogging technology functioned as a valuable structuring resource when the teacher explicitly focused on supporting students' talk for learning (Articles 2 and 3) in both microblogging activities and the lesson as a whole. For instance, the combination of written microblogs and oral talk in the microblogging activities allowed both the teacher and the students to gain insights into other small-group discussions and to bring these into group and whole-class discussions. The way in which the microblogging tool was used in Article 3 also demonstrated the teachers' awareness of the students' contributions. Embedding the microblogging tool in the activity allowed the teacher to direct the discussions in a way that scaffolded students' engagement in talk for learning by encouraging the students

to build on each other, elaborate their ideas and make their reasoning clear. This is in line with findings from other studies (e.g. Mercier et al., 2015; Omland & Rødnes, 2020).

Another aspect of how the microblogging technology functioned as a valuable structuring resource when used in combination with an explicit focus on talk for learning was the teachers' educational design of the lessons. The microblogging lessons frequently shifted between group and whole-class discussions. This was something that characterised all lessons included in the DiDiAC material, as Articles 2 and 3 demonstrated. The design of the microblogging tool, which offers multiple options for participation (i.e. small-group discussions, simultaneous whole-class discussions and access to a feed and a wall) encourages frequent activity shifts. The microblogging design thus seems to facilitate and encourages frequent shifts between small-group and whole-class discussions, which in turn opens more possibilities for students to participate in classroom talk and for the teacher to scaffold the students' participation. This finding is supported by findings from other recent Talkwall studies (Frøytlog & Rasmussen, 2020; Omland & Rødnes, 2020). The microblogging tool thus supported the teachers' practices in the design of educational activities that scaffolded the students' talk for learning.

Wertsch (1998) emphasises that materiality is a property of any mediational means (p. 31). In this thesis, I demonstrate how microblogging can provide a stage of semi-permanence, or materiality, to the spoken language in the form of short written texts appearing on the students' screens during oral discussions. The short 'oral character' of the microblogs adds a new form of materiality to the spoken language that I argue can provide students with the possibility of exploring more and broader perspectives in their small-group discussions. Moreover, the microblogging format can make participation more accessible. Furberg & Silseth (2021) explain how 'student resources' (i.e. previous ideas and assumptions) become mediational means enabling students to express and test out their ideas as accountable participants in the whole class. I believe my study adds to their findings by demonstrating how students' contributions in a short, semi-permanent format such as microblogs through the feed and the wall can become mediational means for participation in whole-class discussions, and thus possibly make participation more accessible for students by lowering the threshold for contributing.

6.3 Methodological contributions

I argue that this thesis makes methodological contributions to the research field of classroom talk and microblogging. In Article 1, we were inspired by thematic analysis to

develop a method to analyse and compare all our collected video data. Studies that apply thematic analysis are usually conducted on a smaller data corpus and often with interview data (Braun & Clarke, 2006). More recently, thematic analysis has been used in combination with interaction analysis, for instance, to justify the selection of episodes to analyse in more depth (Silseth & Erstad, 2018) or to analyse the interdependence between institutional cultures and episodes (Omland, 2021; Omland & Rødnes, 2020). In Article 1, we applied the systematic approach of thematic analysis to explore and analyse the 20 teachers' various strategies across 57 lessons. By combining transcripts alongside video data and data from the microblogging tool and including different situated resources, such as local talk rules, the analysis uncovered multiple levels and aspects of how teachers worked to make talk rules relevant.

Analysing this amount of video and other resources thematically provided us with a systematic overview of a relatively large data corpus and served as an appropriate method to identify and analyse the strategies the teachers used to make talk rules relevant. This systematic approach to both traditional video data with transcriptions, as well as data from the digital and analogue tools, provided unique insight across the data material. The systematic approach also allowed us to go back and forth between the large corpus and the smaller details in the three empirical studies. The combination of analytical levels provided us with robust analytical information, giving us a broad picture across different countries and teachers that was also concentrated and from different perspectives. The analysis of the role of digital technology for classroom talk is challenging because multiple modalities are integrated, making it difficult to determine how and why the technology possibly promotes or prevents talk for learning. In their newly published article, Major et al. (in press) suggest a flexible approach for analysing classroom talk and technology in a process of categorisation and with an inductive and deductive analysis that enables the researcher to explore the role of technology on multiple levels. Their study exemplifies this approach with microblogging technology, demonstrating various ways in which technology affordances are enacted in the classroom. My study uses a similar multiple-level approach as described in Chapter 4.

In addition, this study demonstrates an innovative way to visualise interactions with microblogging technology in the classroom in Articles 2 and 3. When the teacher and students used the microblogging tool, they used multiple modes in their interactions, including text and talk. This represents a challenge when transforming the video data into transcribed text for the article and might even weaken the validity because the richness of the data is reduced. Therefore, to avoid validity threats, Articles 2 and 3 provide the reader with both transcripts and detailed stills demonstrating the multiple modes of student and teacher interactions. For

instance, an image that demonstrates what the students write and read on Talkwall while they talk is presented within a more traditional transcription. This form of representation has been found valuable in contexts such as museums, where it is important to demonstrate for the reader how the visitors interact with the art exhibitions (Steier et al., 2015). I argue that my approach to presenting multimodal data in the context of digital technology in classrooms may increase the readability of the excerpts, which in turn can strengthen the validity of the studies. In addition, the level of detail in this form of representation demonstrates careful consideration in the analysis for not only the oral talk but also the role of the mediating artefacts in the communication by means of the microblogs, as demonstrated in Articles 2 and 3.

6.4 Possible implications of the study

The contribution of this thesis can potentially have meaning beyond the teaching of talk for learning in the classroom. This is especially true when considering that the way in which we communicate has been radically changed due to the digital technologies that have entered our everyday lives. The thesis contributes empirical examples of how teachers can handle some of the temporary challenges in an educational context.

One possible implication that emerges from this study for teachers' development of practice is the potential within microblogging used in combination with systematic work with classroom talk. Teachers in Norwegian classrooms focus much on the students' participation, including whole-class discussions, presentations and group discussions (e.g. Klette et al., 2018; Skaftun & Wagner, 2019; Svenkerud et al., 2012). There has been, however, less systematic work with the development of students' talk skills, and there has been little explicit focus on the specific talk skills that the students need to participate in talk for learning. This is especially true in the context of digital environments, as presented in the introduction (Blikstad-Balas & Klette, 2020; Gilje et al., 2020; Klette et al., 2018). The results from the current study demonstrate that when teachers are provided with resources, such as strategies for explicitly focusing on talk for learning in combination with a microblogging tool, many teachers integrate these new tools in their existing practices. Thus, the provided resources resulted in a broad repertoire of strategies for supporting students' participation in classroom talk as well as opened more possibilities for students to participate in classroom talk. This perhaps indicates that there is a need for researchers to communicate more clearly with teachers, to provide teachers with sufficient resources and to highlight the importance of explicit teaching of talk skills.

Co-located microblogging with tools such as Talkwall can make the practice of thinking critically achievable for classroom practices through the possibility of sharing ideas, and the

collective development of ideas. In other words, co-located microblogging can open a space for the students to safely practice their awareness of other people's voices. The co-located microblogging and the facilitation of the systematic sharing of ideas can also be seen in light of the argument about teaching students how to engage in dialogues beyond the classroom, for instance, in social media. With the microblogging tool Talkwall, it is possible to provide young students with a safe place to practice these types of skills in a hands-on way. The students can practice their social media skills by simultaneously discussing ideas and seeing and discussing opinions face-to-face in the classroom, which may contribute to awareness of other people's voices. Furthermore, teachers can contribute to the development of students' understanding of the importance of respecting and accepting differences and different perspectives in a concrete activity that is suitable for classrooms, which is crucial in today's society where access to information is almost limitless. The combination of written messages and oral talk in, for instance, social media or other platforms that have similar features, means that students today need to learn how to handle this new way of communicating. Also, since students have access to a myriad ideas and perspectives through mobile phones or other devices, they need to learn how to handle all this information and to talk together in ways that are efficient for learning and thinking together within these new environments. During the last few years, the need to learn how to handle multimodal ways of communicating has become even more obvious. The constantly evolving possibilities of instant messaging, the sharing of images and videos, and a mixture of text and speech has embedded multimodal ways of communication in our interactions. The growing public sphere is fuelled by social media where hate speech, conspiracy theories, digital bullying and fake news thrives. Alexander (2020, p. 7) noticed what he calls 'a collision of discourses', pointing to the widening gap between the ways that we want students to talk and reason inside school and those that they encounter outside it. In the public sphere outside school, democratic values seem to be under pressure. To meet this pressure, schoolteachers have an important role in giving students knowledge about democracy, values and rules to prepare them for future participation in democratic processes. To develop this type of knowledge, the capacity to think critically is crucial (Kuhn, 2015). The concept of critical thinking can be difficult to specify exactly, and the capacity to think critically is often considered part of the reasoning within a specific discipline (Kuhn, 1999). However, we can consider critical thinking in more general terms as a skill essential for making good judgements, problematising and having a sense of awareness when engaging with myriad information on social media. Such general competency is essential to be able to contribute to a more rational, civilised society. Considering critical thinking in this way supports the argument of explicitly

teaching students how to engage efficiently in talk for learning and practicing these skills using tools such as Talkwall. It is though productive talk and interaction with others that students can learn how to deal with conflicting opinions and develop ways of accepting and respecting that other have different worldviews, and hence learn from each other on build on each other.

6.5 Reflections and further research

I introduced this extended abstract by arguing that the thesis is simply about how we can use technology to encourage more students to participate in classroom talk. Throughout the thesis, including the three articles, I have explored how microblogging technology can be used in combination with teachers' classroom practices to facilitate and support students' engagement in talk that is productive for learning.

When I started the work with this thesis, I was inquisitive about the fact that the explicit focus on teaching students how to engage in talk for learning is still relatively rare in classrooms (Gilje et al., 2016; Howe et al., 2019; Park et al., 2017). Through the work with this thesis, I contribute results demonstrating how teachers, who do work with such an approach and use tools for explicitly teaching students talk for learning, practice the teaching of talk for learning in their classrooms. These results might contribute to a broader understanding of how teachers and researchers can work together towards increasing the focus on the explicit teaching of productive talk skills and, in particular, how digital technology can contribute to this context.

Still, I believe that more research is needed on systematically teaching students talk for learning, the teachers' attitude towards dialogic teaching and their knowledge about the importance of teaching students talk for learning, especially in digital environments. As digital environments are constantly changing, we also need solid research that follows this continuous development and provides useful insights to teachers and schools who face new challenges on an everyday basis.

References

Alexander, R. (2008). *Towards dialogic teaching: Rethinking classroom talk* (4th ed.). Dialogos UK Ltd.

Alexander, R. (2020). *A dialogic teaching companion*. Routledge.

Arnseth, H. C., & Krange, I. (2016). What happens when you push the button? Analyzing the functional dynamics of concept development in computer supported science inquiry. *International Journal of Computer-Supported Collaborative Learning*, *11*(4), 479–502. https://doi.org/10.1007/s11412-016-9244-4

Baines, E., Blatchford, P., & Chowne, A. (2007). Improving the effectiveness of collaborative group work in primary schools: Effects on science attainment. *British Educational Research Journal*, *33*(5), 663–680. https://doi.org/10.1080/01411920701582231

Bakhtin, M. (1986). *Speech genres and other late essays.* University of Texas Press.

Barnes, D. (2008). Exploratory talk for learning. In N. Mercer & S. Hodgkinson (Eds.), *Exploring Talk in School: Inspired by the Work of Douglas Barnes* (pp. 1–15). SAGE.

Barnes, D., & Todd, F. (1977). *Communication and learning in small groups.* Routledge & Kegan Paul.

Scardamalia, M, & Bereiter, C. (1987). Knowledge telling and knowledge transforming in written composition. In S. Rosenberg (Ed.), Advances in applied psycholinguistics: Vol. 2. Reading, writing, and language learning (pp. 142-175). Cambridge University Press.

Bernstein, B. (1975). *Class, Codes and Action.: Vol. Volume 3: Towards a theory of educational transmissions.* Routledge & Kegan Paul.

Blikstad-Balas, M. (2020). What is the insight from contemporary educational research? In A. S. Michaelsen (Ed), *The digital classroom: Transforming the Way We Learn.* (pp. 110-120). Routledge. https://doi.org/10.4324/9781003104148

Blikstad-Balas, M., & Klette, K. (2020). Still a long way to go: Narrow and transmissive use of technology in the classroom. *Nordic Journal of Digital Literacy*, *15*(01), 55–68. https://doi.org/10.18261/issn.1891-943x-2020-01-05

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Braun, V., & Clarke, V. (2013). *Successful Qualitative Research: A Practical Guide for Beginners*. SAGE.

Bruner, J. (1978). The Role of Dialogue in Language Acquisition. In A. Sinclair, R. Jarvella, and W. Levelt. (Eds.) *The Child's Conception of Language.* (pp.241-256) New York: Springer-Verlag.

Cazden, C. B. (2001). *Classroom discourse. The language of teaching and learning* (2nd ed., Vol. 18). Heinemann. https://linkinghub.elsevier.com/retrieve/pii/0346251X9090014V

Clark, A., Anderson, R. C., Kuo, L., Kim, I., Archodidou, A., & Nguyenjahiel, K. (2003). Collaborative reasoning: Expanding ways for children to talk and think in school. Educational Psychology Review, 15, 181–198.

Cole, M. (1995). A conception of culture for a communication theory of mind. In D. Vocate (Ed.), *Intrapersonal communication: Different voices, different minds* (pp. 77-100). Hillsdale, NJ: Erlbaum.

Den nasjonale forskningsetiske komité for samfunnsvitenskap og humaniora. (2021). *Forskningsetiske retningslinjer for samfunnsvitenskap og humaniora.* https://www.forskningsetikk.no/globalassets/dokumenter/4-publikasjoner-som-pdf/forskningsetiske-retningslinjer-for-samfunnsvitenskap-og-humaniora.pdf

Edwards, D., & Mercer, N. (1987). *Common knowledge: The development of understanding in the classroom*. Methuen.

Flanders, N. (1970). Analysing teacher behaviour as part of the teaching-learning process.

Educational Leadership.

Erstad, O., Kjällander, S., & Järvelä, S. (2021). Facing the challenges of 'digital competence': A Nordic agenda for curriculum development for the 21st century. *Nordic Journal of Digital Literacy*, *16*(02), 77–87. https://doi.org/10.18261/issn.1891-943x-2021-02-02

Fernández, M., Wegerif, R., Mercer, N., & Rojas-Drummond, S. (2002). Re-conceptualizing 'Scaffolding' and the Zone of Proximal Development in the Context of Symmetrical Collaborative Learning. *The Journal of Classroom Interaction*, *36/37*(2/1), 40–54. https://www.jstor.org/stable/23869224

Fischer, F., Kollar, I., Stegmann, K., & Wecker, C. (2013). Toward a Script Theory of Guidance in Computer-Supported Collaborative Learning. *Educational Psychologist*, *48*(1), 56–66. https://doi.org/10.1080/00461520.2012.748005

Frøytlog, J. I. J., & Rasmussen, I. (2020). The distribution and productivity of whole-class dialogues: Exploring the potential of microblogging. *International Journal of Educational Research*, *99*, 101501. https://doi.org/10.1016/j.ijer.2019.101501

Galton, M., Hargreaves, L., Comber, C., Wall, D., & Pell, T. (1999). Changes in patterns of teacher interaction in primary classrooms: 1976-96. *British Educational Research Journal*, *25*(1), 23–37.

Gao, F., Luo, T., & Zhang, K. (2012). Tweeting for learning: A critical analysis of research on microblogging in education published in 2008–2011. *British Journal of Educational Technology*, *43*(5), 783–801. https://doi.org/10.1111/j.1467-8535.2012.01357.x

Gilje, Ø., Bjerke, Å., & Thuen, F. (2020). Gode eksempler på praksis. *Rapport. Oslo: FIKS, UiO*.

Grice, H. P. (1975). Logic and conversation. In P. Cole & J. Morgan (Eds.), *Syntax and Semantics: Vol. Vol. 3* (pp. 41–58). Academic Press.

Hauge, T. E., Lund, A., & Vestøl, J. M. (2007). *Undervisning i endring. IKT, aktivitet, design*. Oslo: Abstrakt forlag.

Heath, S. B. (1983). *Ways with Words: Language, Life and Work in Communities and Classrooms*. Cambridge University Press.

Hennessy, S. (2011). The role of digital artefacts on the interactive whiteboard in supporting classroom dialogue. *Journal of Computer Assisted Learning*, *27*(6), 463–489. https://doi.org/10.1111/j.1365-2729.2011.00416.x

Hennessy, S., & Davies, M. (2019). Teacher professional development to support classroom dialogue: Challenges and promises. In *The Routledge international handbook of research on dialogic education* (pp. 238–253). Routledge.

Howe, C., & Abedin, M. (2013). Classroom dialogue: A systematic review across four decades of research. *Cambridge Journal of Education*, *43*(3), 325–356. https://doi.org/10.1080/0305764X.2013.786024

Howe, C., Hennessy, S., Mercer, N., Vrikki, M., & Wheatley, L. (2019). Teacher–Student Dialogue During Classroom Teaching: Does It Really Impact on Student Outcomes? *Journal of the Learning Sciences*, *28*(4–5), 462–512. https://doi.org/10.1080/10508406.2019.1573730

Jay, T., Willis, B., Thomas, P., Taylor, R., Moore, N., & Burnett, C. (2017). *Dialogic Teaching: Evaluation report and executive summary*. Education Endowment Foundation. https://educationendowmentfoundation.org.uk/public/files/Projects/Evaluation_Reports/Dialogic_Teaching_Evaluation_Report.pdf

Kazak, S., Wegerif, R., & Fujita, T. (2015). Combining scaffolding for content and scaffolding for dialogue to support conceptual breakthroughs in understanding probability. *ZDM*, *47*(7), 1269–1283. https://doi.org/10.1007/s11858-015-0720-5

Kerawalla, L. (2015). Talk Factory Generic: Empowering secondary school pupils to construct

and explore dialogic space during pupil-led whole-class discussions. *International Journal of Educational Research*, *70*, 57–67. https://doi.org/10.1016/j.ijer.2014.12.003

Kerawalla, L., Petrou, M., & Scanlon, E. (2013). Talk Factory: Supporting 'exploratory talk' around an interactive whiteboard in primary school science plenaries. *Technology, Pedagogy and Education*, *22*(1), 89–102. https://doi.org/10.1080/1475939X.2012.745049

Kershner, R., Mercer, N., Warwick, P., & Kleine Staarman, J. (2010). Can the interactive whiteboard support young children's collaborative communication and thinking in classroom science activities? *International Journal of Computer-Supported Collaborative Learning*, *5*(4), 359–383. https://doi.org/10.1007/s11412-010-9096-2

Kirschner, P. A. (2002) Can we support CSCL? Educational, social and technological affordances for learning. In P. Kirschner (Ed.) *Three worlds of CSCL: can we support CSCL*. (pp. 7–47). Heerlen, Open University of the Netherlands.

Klette, K., Sahlström, F., Blikstad-Balas, M., Luoto, J., Tanner, M., Tengberg, M., Roe, A., & Slotte, A. (2018). Justice through participation: Student engagement in Nordic classrooms. *Education Inquiry*, *9*(1), 57–77. https://doi.org/10.1080/20004508.2018.1428036

Kollar, I., Fischer, F., & Slotta, J. D. (2007). Internal and external scripts in computer-supported collaborative inquiry learning. *Learning and Instruction*, *17*(6), 708–721. https://doi.org/10.1016/j.learninstruc.2007.09.021

Kuhn, D. (1999). A developmental model of critical thinking. *Educational Researcher*, *28*(2), 16–46.

Kuhn, D. (2015). Thinking Together and Alone. *Educational Researcher*, *44*(1), 46–53. https://doi.org/10.3102/0013189X15569530

Lantz-Andersson, A. (2016). Embracing social media for educational linguistic activities. *Nordic Journal of Digital Literacy*, *11*(01), 50–77.

Lawrence, J. F., & Snow, C. E. (2011). Oral discourse and reading. In *Handbook of reading research, Volume IV* (pp. 346–364). Routledge.

Leung, L. (2015). Validity, reliability, and generalizability in qualitative research. *Journal of Family Medicine and Primary Care*, *4*(3), 324. https://doi.org/10.4103/2249-4863.161306

Littleton, K., & Mercer, N. (2013). *Interthinking: Putting talk to work*. Routledge. https://doi.org/10.4324/9780203809433

Ludvigsen, K., Ness, I. J., & Timmis, S. (2019). Writing on the wall: How the use of technology can open dialogical spaces in lectures. *Thinking Skills and Creativity*, *34*, 100559. https://doi.org/10.1016/j.tsc.2019.02.007

Lund, A., & Rasmussen, I. (2008). The right tool for the wrong task? Match and mismatch between first and second stimulus in double stimulation. *International Journal of Computer-Supported Collaborative Learning*, *3*(4), 387–412. https://doi.org/10.1007/s11412-008-9050-8

Luo, T. (2015). Instructional guidance in microblogging-supported learning: Insights from a multiple case study. *Journal of Computing in Higher Education*, *27*(3), 173–194. Scopus. https://doi.org/10.1007/s12528-015-9097-2

Luo, T., & Gao, F. (2012). Enhancing Classroom Learning Experience by Providing Structures to Microblogging-based Activities. *Journal of Information Technology Education: Innovations in Practice*, *11*, 199–211. https://doi.org/10.28945/1689

Maine, F., & Hofmann, R. (2016). Talking for meaning: The dialogic engagement of teachers and children in a small group reading context. *International Journal of Educational Research*, *75*, 45-56. https://doi.org/10.1016/j.ijer.2015.10.007

Major, L., Smørdal, O., Warwick, P., Rasmussen, I., Cook, V. & Vrikki, M. (in press).

Investigating digital technology's role in supporting classroom dialogue: Integrating enacted affordance into analysis across a complex dataset. International Journal of Research & Method in Education.

Major, L., & Warwick, P. (2019). Affordances for dialogue: The role of digital technology in supporting productive classroom talk. In N. Mercer, R. Wegerif, & L. Major (Eds.), *The Routledge international handbook of research on dialogic education* (pp. 394–410). Routledge.

Major, L., Warwick, P., Rasmussen, I., Ludvigsen, S., & Cook, V. (2018). Classroom dialogue and digital technologies: A scoping review. *Education and Information Technologies*, *23*(5), 1995–2028. https://doi.org/10.1007/s10639-018-9701-y

Maybin, J. (2006). *Children's voices: Talk, knowledge and identity*. Palgrave MacMillan. Mehan, H. (1979). *Learning lessons: Social organization in the classroom.* Harvard University Press.

Mercer, N. (1995). *The guided construction of knowledge: Talk amongst teachers and learners*. Multilingual Matters.

Mercer, N. (2002). *Words and minds: How we use language to think together*. Routledge.

Mercer, N., & Dawes, L. (2014). The study of talk between teachers and students, from the 1970s until the 2010s. *Oxford Review of Education*, *40*(4), 430–445. : https://doi.org/10.1080/03054985.2014.934087

Mercer, N., Fernandez, M., Dawes, L., Wegerif, R., & Sams, C. (2003). Talk about texts at the computer: Using ICT to develop children's oral and literate abilities. *Reading*, *37*(2), 81–89. https://doi.org/10.1111/1467-9345.3702006

Mercer, N., Hennessy, S., & Warwick, P. (2019). Dialogue, thinking together and digital technology in the classroom: Some educational implications of a continuing line of inquiry. *International Journal of Educational Research*, *97*, 187–199. https://doi.org/10.1016/j.ijer.2017.08.007

Mercer, N., & Littleton, K. (2007). *Dialogue and the Development of Children's Thinking: A Sociocultural Approach*. Routledge. https://doi.org/10.4324/9780203946657

Mercer, N., Wegerif, R., & Dawes, L. (1999). Children's Talk and the Development of Reasoning in the Classroom. *British Educational Research Journal*, *25*(1), 95–111. https://doi.org/10.1080/0141192990250107

Mercier, E., Rattray, J., & Lavery, J. (2015). Twitter in the collaborative classroom: Micro-blogging for in-class collaborative discussions. *International Journal of Social Media and Interactive Learning Environments*, *3*(2), 83. https://doi.org/10.1504/IJSMILE.2015.070764

Michaels, S., O' Connor, M. C., Hall, M. W., & Resnick, L. B. (2016). *Accountable Talk® Sourcebook: For classroom conversation that works*. Institute for learning, University of Pittsburgh.

Muhonen, H., Pakarinen, E., Poikkeus, A.-M., Lerkkanen, M.-K., & Rasku-Puttonen, H. (2018). Quality of educational dialogue and association with students' academic performance. *Learning and Instruction*, *55*, 67–79. https://doi.org/10.1016/j.learninstruc.2017.09.007

Omland, M. (2021). Technology-aided meaning-making across participation structures: Interruptions, interthinking and synthesising. *International Journal of Educational Research*, *109*, 101842. https://doi.org/10.1016/j.ijer.2021.101842

Omland, M., & Rødnes, K. A. (2020). Building agency through technology-aided dialogic teaching. Learning, Culture and Social Interaction, 26, 100406. https://doi.org/10.1016/j.lcsi.2020.100406

Palinscar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction*, *1*(2), 117–175.

Park, J., Michaels, S., Affolter, R., & O'Connor, C. (2017). Traditions, research, and practice supporting academically productive classroom discourse. In G. Noblit (Ed.), *Oxford research encyclopedia of education*. Oxford University Press.

Pea, R. D. (2004). The social and technological dimensions of scaffolding and related theoretical concepts for learning, education, and human activity. The Journal of the Learning Sciences, 13(3), 423–451. https://doi.org/10.1207/s15327809jls1303_6

Preston, J. P., Jakubiec, B. A. E., Jones, J., & Earl, R. (2015). Twitter in a Bachelor of Education Course: Student Experiences. *LEARNing Landscapes*, *8*(2), 301–317. https://doi.org/10.36510/learnland.v8i2.710

Rasmussen, I., & Hagen, Å. (2015). Facilitating students' individual and collective knowledge construction through microblogs. *International Journal of Educational Research*, *72*, 149–161. https://doi.org/10.1016/j.ijer.2015.04.014

Rasmussen, I., & Rødnes, K. A. (2020). Dialog + microblogging = flerstemmighed? In O. Dysthe, I. J. Ness, & P. O. Kirkegaard (Eds.), *Dialogisk pædagogik, kreativitet og læring* (pp. 217–248). Forlaget Klim.

Rojas-Drummond, S., & Zapata, M. P. (2004). Exploratory Talk, Argumentation and Reasoning in Mexican Primary School Children. *Language and Education*, *18*(6), 539–557. https://doi.org/10.1080/09500780408666900

Sahlström, F., Tanner, M., & Valasmo, V. (2019). Connected youth, connected classrooms. Smartphone use and student and teacher participation during plenary teaching. *Learning, Culture and Social Interaction*, *21*, 311–331. https://doi.org/10.1016/j.lcsi.2019.03.008

Scardamalia, M. (2004). CSILE/Knowledge Forum. In *Education and technology: An encyclopedia* (pp. 183–192).

Silseth, K., & Erstad, O. (2018). Connecting to the outside: Cultural resources teachers use when contextualizing instruction. *Learning, Culture and Social Interaction*, *17*, 56–68. https://doi.org/10.1016/j.lcsi.2017.12.002

Sinclair, J. M., & Coulthard, M. (1975). *Towards an analysis of discourse: The English used by teachers and pupils*. Oxford University Press.

Skaftun, A., & Wagner, Å. K. H. (2019). Oracy in year one: a blind spot in Norwegian language and literacy education? L1 Educational Studies in Language and Literature, 19, 1–20. https://doi.org/10.17239/ L1ESLL-2019.19.01.09

Smørdal, O., Rasmussen, I., & Major, L. (2021). Supporting classroom dialogue through developing the Talkwall microblogging tool: Considering emerging concepts that bridge theory, practice, and design. *Nordic Journal of Digital Literacy*, *16*(02), 50–64. https://doi.org/10.18261/issn.1891-943x-2021-02-02

Staarman, J. K. (2009). The joint negotiation of ground rules: Establishing a shared collaborative practice with new educational technology. *Language and Education*, *23*(1), 79–95. https://doi.org/10.1080/09500780802152796

Steier, R., Pierroux, P., & Krange, I. (2015). Embodied interpretation: Gesture, social interaction, and meaning making in a national art museum. *Learning, Culture and Social Interaction*, *7*, 28–42. https://doi.org/10.1016/j.lcsi.2015.05.002

Svenkerud, S., Klette, K., & Hertzberg, F. (2012). Opplæring i muntlige ferdigheter. *Nordic* Studies in Education, 32(01), 35–49. https://doi.org/10.18261/ISSN1891-5949-2012-01-03

Tabak, I. (2004). Synergy: A complement to emerging patterns of distributed scaffolding. *The Journal of the* Learning Sciences, 13(3), 305–335. https://doi.org/10.1207/s15327809jls1303_3

Twiner, A., Coffin, C., Littleton, K., & Whitelock, D. (2010). Multimodality, orchestration and

participation in the context of classroom use of the interactive whiteboard: A discussion. *Technology, Pedagogy and Education*, *19*(2), 211–223. https://doi.org/10.1080/1475939X.2010.491232

Twiner, A., Littleton, K., Whitelock, D., & Coffin, C. (2021). Combining sociocultural discourse analysis and multimodal analysis to explore teachers' and pupils' meaning making. Learning, Culture and Social Interaction, 30, 100520. https://doi.org/10.1016/j.lcsi.2021.100520

Valsiner, J., & Van der Veer, R. (2000). *The social mind: Construction of the idea*. Cambridge University Press.

van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in Teacher–Student Interaction: A Decade of Research. *Educational Psychology Review*, *22*(3), 271–296. https://doi.org/10.1007/s10648-010-9127-6

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Warwick, P., Mercer, N., & Kershner, R. (2013). 'Wait, let's just think about this': Using the interactive whiteboard and talk rules to scaffold learning for co-regulation in collaborative science activities. *Learning, Culture and Social Interaction*, *2*(1), 42–51. https://doi.org/10.1016/j.lcsi.2012.12.004

Warwick, P., Mercer, N., Kershner, R., & Staarman, J. K. (2010). In the mind and in the technology: The vicarious presence of the teacher in pupil's learning of science in collaborative group activity at the interactive whiteboard. *Computers & Education*, *55*(1), 350–362. https://doi.org/10.1016/j.compedu.2010.02.001

Wegerif, R. (1996). Using computers to help coach exploratory talk across the curriculum. *Computers & Education*, *26*(1–3), 51–61.

Wegerif, R. (2007). *Dialogic education and technology: Expanding the space of learning: Vol. Vol. 7*. Springer Science & Business Media.

Wegerif, R., & Dawes, L. (2004). *Thinking and Learning with ICT, Raising achievement in primary classrooms*. Routledge. https://doi.org/10.4324/9780203506448

Wells, G. (1999). *Dialogic Inquiry: Towards a Socio-cultural Practice and Theory of Education* (1st ed.). Cambridge University Press. https://doi.org/10.1017/CBO9780511605895

Wells, G. (2009). *The meaning makers: Learning to talk and talking to learn*. Multilingual Matters.

Wertsch, J. V. (1998). *Mind as action*. Oxford University Press.

Wood, D., Bruner, J. S., & Ross, G. (1976). The Role of Tutoring in Problem Solving*. *Journal of Child Psychology and Psychiatry*, *17*(2), 89–100. https://doi.org/10.1111/j.1469-7610.1976.tb00381.x

Appendix 1

Figure 2

An example of the communicative event analysis, integrated with data from Talkwall (see Major et al., 2022 for further elaboration.

Min	TS	Local time	Class	Group	Indiv	Interactive	Non-interactive	Talkwall (T-Led)	Talkwall (S-Led)	2nd coder	Talkwall time	Teacher (log data)	Feed (log data)	Wall (log data)	Lesson Narrative
32	[00:32:00]	10:15:54		1		1			1		10:16	0	7	10	
33	[00:33:00]	10:16:54		1		1			1		10:17	0	7	28	
34	[00:34:00]	10:17:54		1		1			1		10:18	0	7	16	
35	[00:35:00]	10:18:54		1		1			1		10:19	0	5	13	T circulating around class.
36	[00:36:00]	10:19:54		1		1			1		10:20	0	5	8	
37	[00:37:00]	10:20:54		1		1			1		10:21	0	8	26	
38	[00:38:00]	10:21:54	1				1	1			10:22	0	2	93	T ends task. Says he is pleased with contributions made. T asks Ss to build their own TW, and to identify 3 advantages and 3 disadvantages.
39	[00:39:00]	10:22:54	1				1	1			10:23	0	0	51	
40	[00:40:00]	10:23:54		1		1			1		10:24	0	0	63	

PART II: THE ARTICLES

ARTICLE 2

Teaching talk for learning during co-located microblogging activities

Amundrud, Rasmussen and Warwick

Abstract

This study investigates the situated practices associated with the establishment of a dialogic classroom ethos, viewed as an interactional achievement. Our analysis focuses on the details of how one teacher attempted to engage students with the purposes and practices of talk for learning during co-located microblogging activities. Our analysis reveals the range of digital and traditional resources used to weave talk rules, created together with the students, into the fabric of classroom interactions. As part of the analysis, we examine the students' uptake of the practices appropriate to talk for learning in peer group interactions during co-located microblogging activities. Through our analysis and illustrations of the unfolding trajectory of a lesson, we consider how this interactional work is played out in a multimodal, technology-rich classroom. This article adds to our understanding of how jointly established talk rules can contribute to the development of a dialogic classroom ethos when using digital technologies. The significance of this analysis lies in its demonstration of how microblogs became a collective scaffold and how microblogging changed the mode of interaction in the classroom. This research extends our understanding of how teachers can use a specific digital technology like microblogging to promote students' engagement in talk for learning, a matter of importance in increasingly digitalised schools.

1. Introduction

An increasing number of studies have highlighted the importance of teaching students how to use talk to express themselves, think collectively, co-construct knowledge and understanding, and solve problems together in the classroom (Howe et al., 2019; Muhonen et al., 2018). Students who are taught how to engage in such talk seem to perform better in terms of critical thinking, collaborative problem-solving, reading comprehension, and achievement on math and English tests (Howe & Abedin, 2013; Kuhn, 2015; Lawrence & Snow, 2010; Mercer, 2019). However, much of the associated research reveals that today, there is limited focus on teaching students *how* to engage in such talk for learning in classrooms (Gilje et al., 2016; Howe et al., 2019). We also know that teachers struggle with establishing the type of dialogic classroom ethos that encourages talk for learning due to various issues, such as lack of experience and concrete resources, time constraints, and challenges stemming from the presence of digital technologies (Hennessy & Davies, 2019; Mercer et al., 2019; Muhonen, et al., 2018; Park et al., 2017). Therefore, we argue that more knowledge is needed regarding the ways in which teachers establish the dialogic classroom ethos needed to engage students in talk for learning.

To address this concern, we investigate in detail how one teacher, who is engaged in the establishment of a dialogic classroom ethos, conducts her work in the context of new digital technology. We acknowledge that digital technology, when used in line with appropriate pedagogy, can be a powerful tool for potentially supporting and encouraging students' engagement in talk for learning (Major et al., 2018). However, we recognise that using digital technologies in the classroom can also introduce more complexity, even to the point of hindering classroom learning (Blikstad-Balas, 2015; Sana et al., 2013). In addition, the ways in which students are used to interacting with other people by using technology (e.g. via social media sites, messaging and chats) is likely to differ from the high-quality talk for learning that is accepted in the classroom (Lantz-Andersson, 2016; Staarman, 2009). Therefore, teachers need to focus on the ways in which students in the classroom should engage in talk for learning while using digital technology, as the use of technology (including platforms that offer messaging and chat functionalities) in classrooms continues to increase (Säljö, 2018). Naturally, teachers also need supportive tools and examples of practices that enhance and promote students' engagement in talk for learning in digital contexts (Mercer et al., 2019). These issues are addressed in the present study, which considers the situated practices associated with establishing a dialogic classroom ethos as an interactional achievement, using

both the idea of talk rules and a specific digital technology, particularly co-located microblogging.

In recent studies, microblogging has been reported to be a promising tool for supporting classroom talk (Omland et al., 2019; Warwick et al., 2020). The microblogging tool used in this study is called 'Talkwall' and has been specifically designed to support talk for learning.[1] Talkwall is a co-located microblogging tool, meaning that it is intended to be used in real time with students in the classroom. The tool was developed as part of a larger research project called Digitalised Dialogues Across the Curriculum (DiDiAC), which focused on the development of teaching practices that promote talk for learning in the context of using Talkwall. In this article we present the work of one teacher, who participated in the DiDiAC project, and her class of 23 lower secondary students from a school located in Oslo, Norway. We address the following research questions:

- In what ways did the teacher make relevant for the students the purposes and practices of talk for learning during co-located microblogging activities?

- What was the students' uptake of the practices of talk for learning during group interactions?

Our aim is to broaden scholarly understanding of how jointly established talk rules can help develop a dialogic classroom ethos and hence foster students' engagement in talk for learning when using digital technologies that may change some modes of interaction in the classroom. In our presentation of the results, we include modified images to illustrate the excerpts in realistic settings while following the relevant anonymisation regulations. We believe that modified images can contribute to our field of research by providing clarity and demonstrating the rigorous process of analysing multiple levels of interaction.

2. Theoretical underpinnings and review of research

2.1 Situated practices associated with the establishment of a dialogic classroom ethos

Sociocultural research for decades has emphasised the importance of scaffolding language development and social interactions (Bruner, 1978; Wertsch, 1998; Wood et al., 1976). Scaffolding involves a specific form of support that should be both contingent, meaning that it is flexible regarding the learner's developmental level, and temporary, meaning that the scaffolds are gradually removed. Although initial scaffolding studies entailed one adult and

---

1 https://talkwall.uio.no/

one child, later studies have emphasised that scaffolding can be provided both by peers and tools (Fernández et al., 2002; Warwick et al., 2010) or in the form of the teachers' educational design (Cazden, 2001). Wood et al. (1976) identified six properties that characterise how scaffolding from a more capable person functions for the learner. Later, Pea (2004) suggested that there are two primary groups of scaffolding properties: (1) channelling and focusing as well as (2) modelling (Pea, 2004). Channelling and focusing refer to the way in which learners are directed towards completing a task by the reduction of their associated degrees of freedom and the provision of constraints. Modelling refers to ways of demonstrating and describing more advanced procedures for performing a particular task (Pea, 2004). These are concepts that we use in our analysis.

Within sociocultural research, especially studies focusing on the role of dialogue, the way in which students talk together in the classroom is central. Research has highlighted the benefits of teaching students educationally productive ways of talking (e.g. Mercer et al., 1999; Wells, 2009). This well-established idea, broadly referred to as dialogic teaching, has been variously interpreted (Kim & Wilkinson, 2019), yet there is general agreement that in order for students to engage in talk for learning, the classroom ethos is a central concern. The creation of a *dialogic* classroom ethos and the explicit teaching of talk skills can foster students' development of talk for learning (Alexander, 2020). In this article we refer to a dialogic classroom ethos as a setting that provides students with opportunities to express themselves, think collectively, co-construct knowledge and understanding, and solve problems together. In other words, a key objective is to develop a classroom ethos that encourages students to participate in discussions in which they can think and construct new knowledge together (Mercer & Littleton, 2007; Wells, 2009). This requires an open and secure classroom where more than one voice or perspective is promoted (Alexander, 2020) and an environment in which students feel relatively at ease and unafraid of being aggressively contradicted or mocked (Barnes, 1976).

One way of establishing a dialogic classroom ethos is to negotiate guiding principles associated with how to approach talk. The development of talk rules is a specific example of how this can be done. Together, students and teachers develop a set of basic norms for classroom talk, which are to be used when students talk and collaboratively solve problems (Mercer & Littleton, 2007) and when the teacher models such talk when interacting with students. The talk rules embody the characteristics of exploratory talk (Barnes & Todd, 1976; Mercer & Littleton, 2007) and accountable talk (Michaels et al., 2008), with the overall

intention for people to engage in forms of talk that are productive for sharing ideas and co-creating joint perspectives. Talk rules can, for example, be that students are encouraged to share all ideas, provide the reasoning behind any opinions stated and listen respectfully to each other. It is important to note that exploratory forms of talk are, of course, not the only kind of talk in a classroom. There are, for example, authoritative talk, instructional talk and talk around behaviour management (Mortimer & Scott, 2003). All these forms of talk are important; however, there is usually less dialogic talk in classrooms than there might be if a dialogic ethos have been established.

That said, simply creating and introducing talk rules are not enough to ensure students' uptake of what counts as talk for learning. Studies have shown that students need to be guided and advised in this regard. The talk rules should be applied in authentic contexts and must be integrated with tasks and activities in meaningful ways (Mercer & Littleton, 2007; Warwick et al., 2020). Moreover, these talk rules should always reflect the classroom environment in which they are established and should be adjusted or developed if environment changes.

Regular direct interventions by the teacher, encouraging the use of procedural routines such as the focus on talk rules, can help establish these rules in the minds of the students (Warwick et al., 2010). 'Thinking Together' is an intervention programme through which (1) teachers and students co-create talk rules and (2) the class learns that language is a tool for thinking. The programme includes materials and lesson activities to help teachers broaden their repertoire of dialogic teaching practices and has been tested in various schools in several countries. Multiple studies have demonstrated that this intervention can help students develop their use of language in a way that benefits learning (Howe et al., 2019; Littleton & Mercer, 2013; Mercer & Dawes, 2014; Mercer et al., 2004; Warwick et al., 2010). As mentioned, teachers who introduce talk rules, should ensure that these rules always reflect the classroom environment in which they are being established. This means, for instance, that when digital technology is brought into the classroom the talk rules might need adjustment to be effective in the new context. In the following sections, we will review literature that focuses on the ways in which digital technology, especially microblogging, can be used to support talk for learning and how such technology possibly changes the modes of interaction.

2.2 Talk for learning and co-located microblogging

It is evident that there is growing interest in the literature regarding the ways that digital technology can support students' engagement in talk for learning (Major et al., 2018). Recent

studies have examined the mediating role of various tools, such as microblogging (Rasmussen & Hagen, 2015; Warwick et al., 2020) and wikis (Pifarré & Li, 2018), in classroom talk. Pifarré and Li (2018) provide empirical evidence from secondary schools about how the combination of face-to-face and written interactions with wiki technology support talk for learning. One finding is that when two modes of collaboration were combined (i.e. face-to-face interaction and written interaction, mediated through wiki technology), the wiki environment afforded the emergence of mutual engagement in collaborative thinking. This was because the wiki provided a space that collected all the users' contributions. Within this space, the students could discuss and reflect on others' ideas. Thus, the wiki became a dialogic space (Wegerif, 2007) where different perspectives could interact and learning could take place. Similarly, in another study, secondary school students used a co-located microblogging tool called 'Socius' to write short summaries that were displayed on a shared screen in the classroom. The study showed that microblogging technology made students' thinking visible to each other and opened up a dialogic space with new possibilities for classroom talk. Furthermore, the use of technology increased participation and seemed to align the students' understanding of the topic with that of the teacher, as the whole-class discussions were based on the students' own work and used by the teacher to initiate further elaboration (Rasmussen & Hagen, 2015). Moreover, Mercier et al. (2015) found that using the microblogging tool Twitter during classroom activities increased the amount of on-task talk and allowed instructors to redirect discussions during activities. The authors also found that the ability to use the shared representation of the tweets to direct the whole-class final conversation allowed for more focused discussions. However, using digital technology might also change how students interact with each other and how teachers interact with students. In one study, Staarman (2009) found that introducing a new digital tool into the classroom changed the nature of interaction and collaboration within it and, thereby, required a re-establishment of the class talk rules that were relevant to the new class set-up. The study indicates how and why the development and establishment of talk rules can benefit students' engagement in talk for learning. Further, the author argues that in the context of the use of a new digital tool, the purpose and use of rules for talk require further discussion between the teacher and students to re-establish their usefulness in relation to working with the new tool.

2.3 Positioning of the study

This brief literature review illustrates how the development of a dialogic classroom ethos can be a complex endeavour that demands explicit work from teachers and students in creating and maintaining clear guidelines for ways of talking in the classroom. Jointly established talk rules can promote students' talk for learning. It is important that the teacher models the use of talk rules in whole-class exchanges (Mercer & Littleton, 2007) and clarifies the dialogic intentions for student group work (Warwick et al., 2020); also, adaptations should be made with respect to the context and resources such as digital technology (Staarman, 2009). The teacher also needs to be persistent in emphasising the jointly created rules so that they become a natural part of how the students work together. Central to the current article is the investigation of a classroom in which the teacher set out to have a *dual focus* on actively using digital technology and introducing talk rules to foster students' engagement in talk for learning in order to create a dialogic classroom ethos.

3. Methods

## 3.1 Context of the study and data

The teacher and students on whom we focus in this article participated in the design-based research project DiDiAC. The aim of the research project was to develop teaching practices to support students' participation in talk for learning using the microblogging tool Talkwall and resources developed from the Thinking Together approach (Mercer et al., 1999). Talkwall (Figure 1) was designed to support co-located interactions through both oral and written communication. During a lesson, Talkwall is usually displayed to the class with a projector or a large screen controlled by the teacher. The students have their own individual or group walls that can be accessed and controlled using any device with a web browser. The teacher has access to all the participants' walls and the ability to show the class any contribution to the shared screen.

The collected data material from the DiDiAC project consists of 57 video-recorded lessons of 14 teachers from Norway and six teachers from the United Kingdom. All lessons were recorded using two cameras: one that focused on the teacher and another that focused on a group of students. The videos were recorded throughout the span of one semester. The data were collected following appropriate guidelines (Norwegian Data Protection Services, 2021). The video recordings were transcribed verbatim, analysed in the original language and

translated for the purpose of this article. The Talkwall microblogs were integrated into the transcript to determine the role of written contributions in face-to-face talk.

Figure 1

Talkwall
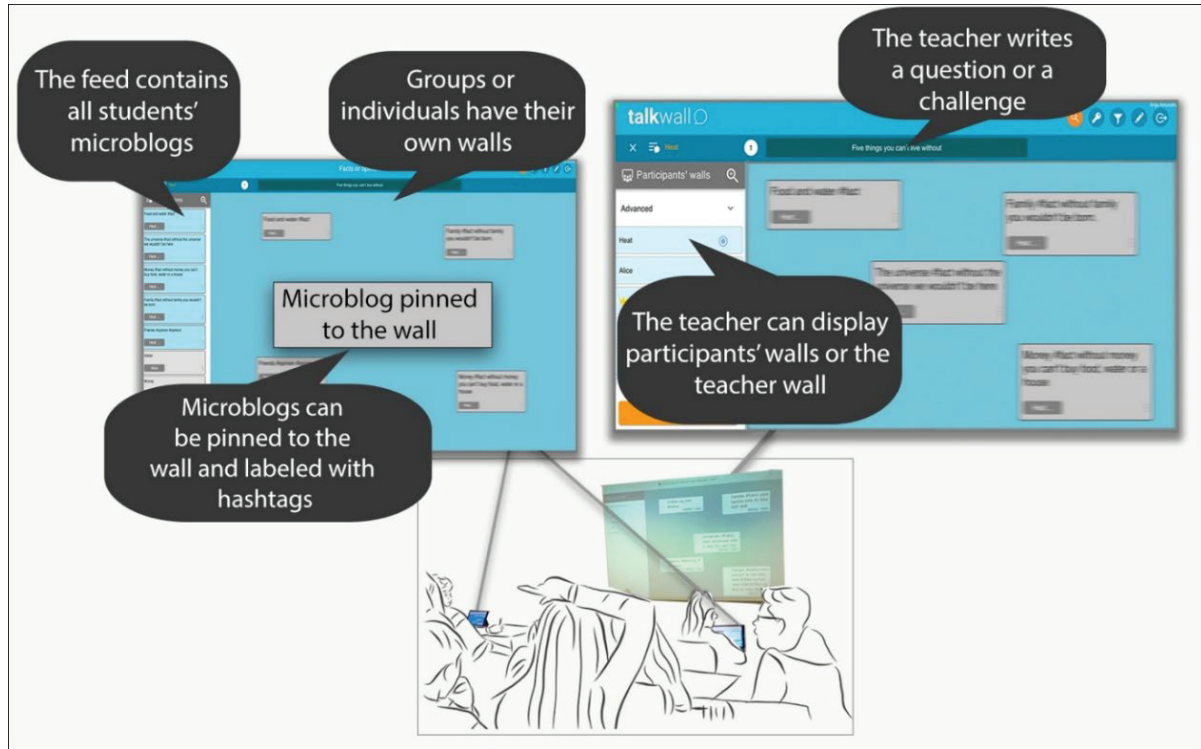
An illustration of a student wall on the left-hand side and a teacher wall on the right-hand side

3.2 Selection of the case

The selection of the case analysed in the present paper stems from a rigorous analysis all the data from the DiDiAC project. This initial part of the analysis was conducted in two phases, involving several members of the DiDiAC research team. Together, we coded the material on both a minute-by-minute basis and through a turn-by-turn deductive analysis. Details of the analytical procedure are described in Appendix A and Major et al. (2022). During these initial phases of analysis, the three lessons led by the teacher in focus stood out in terms of (1) frequent activity shifts, (2) an active use of Talkwall, (3) a high number of productive turns and (4) the ways that this teacher systematically made explicit references to the talk rules in every recorded lesson.

3.3 Detailed analyses of the selected case

Having selected the case, we conducted a thematic analysis of the three lessons by this teacher that were recorded, inspired by Braun and Clarke (2006, 2013). We did this by

systematically reviewing the video recordings of the lessons, along with corresponding transcripts. Excel and NVivo12 software were used to store and organise the data (see Appendix B for an illustration of our minute-by-minute coding process and thematic categorisation). All three lessons were examined, and we identified instances in which the teacher explicitly referred to ways to talk for learning and/or talk rules. The recordings were then viewed again, directing attention to instances with an explicit focus on talk for learning or talk rules. In this process we inductively identified five main categories that thematically describe the methods that this teacher used to make the purposes and practices of talk for learning relevant for the students (see sections 4 and 5). We then selected one lesson for further in-depth scrutiny. We chose the lesson, revealed by the thematic analysis, in which the teacher used the most varied strategies to engage students in talk for learning. The lesson was therefore especially suited to investigating our research questions.

In further analysis of the selected lesson, we used a video-based sociocultural analysis of the interactions (Mercer, 2004), which assumes that digital technology is one of many cultural resources that mediate the interactional process (Derry et al., 2010; Mercer, 2008). Previous studies, addressing how topics are introduced and picked up, have emphasised the importance of investigating learners' interactions across situations and time (Kershner et al., 2020; Mercer, 2008; Rasmussen, 2012; Twiner et al., 2021). Following these studies, the entire lesson was examined. This included the participants' utterances *and* actions (e.g. contributing to Talkwall and displaying Talkwall contributions). We also drew on actions – such as gestures, gaze and tone of voice – to clarify references that may have otherwise been ambiguous.

Our analysis during this phase involved two levels: the trajectory level and the interactional level. These levels inform each other, providing insights into how knowledge and activities become relevant at specific times and how they stay relevant throughout an activity (Rasmussen, 2012). Our unit of analysis was therefore the participants' interactions over time. First, we focused on how the teacher worked throughout the trajectory of the lesson to promote talk for learning and on the instances that we identified by using thematic analysis. Next, we focused on how the students picked up on the teachers' introduction of talk for learning during the group work.

In this process we used the concept of participation trajectory to trace the interactional work throughout the lesson to specify the teacher's and students' interactions and their use of available resources. This concept provided us with insights into the series of events that might have led to progression in the students' way of using the language in productive ways. As

Rasmussen (2012) explains, 'To reflect dynamic changes and to account for the embeddedness of learning in and through various temporal and spatial dimensions, participation is often combined with trajectories to describe the processes and results of having taken part in activities over time' (p. 3334). To achieve analytical precision, the concept of participation trajectories needs analytical specification; therefore, we used the concept of scaffolding, as described in the theory section. Hence, in our analytical work we focused on the ways in which the students' talk for learning was scaffolded by the teacher by reducing the associated degrees of freedom and providing constraints, and whether the students talk, and interactions demonstrated uptakes of the teacher's attempt to engage students with the purposes and practices of talk for learning.

To provide the reader with a rich contextual description of the lesson, we present a storyline of five excerpts, each from a different part of the lesson, in the results section (Figure 2). The selected whole-class excerpts (1, 3 and 5), taken together, detail the various forms of the identified strategies that this teacher uses, as categorised in the thematic analysis. These excerpts are meant to demonstrate the *variation* in this teacher's ways of making relevant for the students how to talk together productively. The selected excerpts from the group work (2 and 4) are *representative* of how this group interacted throughout the span of the lesson. Moreover, they demonstrate, as we identified, the various ways that the microblogging tool Talkwall enabled the students to engage in peer group interactions that follow what the teacher introduced as talk for learning in this lesson.

Presenting multiple modes of data material, particularly multimodal resources such as Talkwall, comes with certain challenges. These include providing sufficient information about the context (Candela et al., 2004). Hence, the five excerpts presented below are multimodal and include visual representations of the teacher and students using Talkwall and other classroom resources. By presenting modified stills from the video recordings, we provide the reader with realistic settings while abiding by strict regulations regarding the anonymisation of data. The use of multimodal transcripts also enabled us to explore the complex interweaving of multimodal interactions between the students, the teacher and Talkwall (Twiner et al. 2021).

The following excerpts reveal how the teacher used certain verbal and nonverbal resources and what this work looks like in the classroom context. The excerpts were translated from Norwegian by the authors and are presented with standard punctuation (Mercer, 2019). The double parentheses contain the analyst's comments or descriptions, while the ellipses

indicate that certain portions of the text have been removed due to their lesser relevance in the given context. The italicised text indicates text that was read aloud, for instance, from Talkwall.

4. Results

4.1 The class and teacher

The school included in the present study is located in the centre of a large Norwegian city, and the participants consisted of 23 students (aged 12–13) and their teacher. The teacher's involvement in the DiDiAC project introduced her to the central elements of the Thinking Together approach (Mercer et al., 1999), and the teacher and her class developed and agreed upon a list of six talk rules, which were displayed on a permanent wall poster. Thus, the teacher highlighted in this article was in the process of developing her ideas regarding creating a dialogic classroom ethos. The teacher's and the class's development of talk rules followed in line with resources suggested in the Thinking Together approach. The teacher and the students thus collectively discussed a number of potential talk rules, and through group and whole-class discussions, they together agreed upon a list of six talk rules. The development of the talk rules was completed about two weeks before the video-recorded lesson. The teacher was familiarised with the functionalities offered by Talkwall and the potential uses of microblogging in classroom activities. The teacher, however, was unfamiliar with how microblogging could be used for educational activities prior to this project. Still, she had previous experience with other digital tools. Students in the class had their own iPads and were familiar with their use, both in the classroom and at home. In this class the students were placed in groups of three, with each group sharing one iPad. The teacher's computer was connected to a whiteboard in front of the classroom.
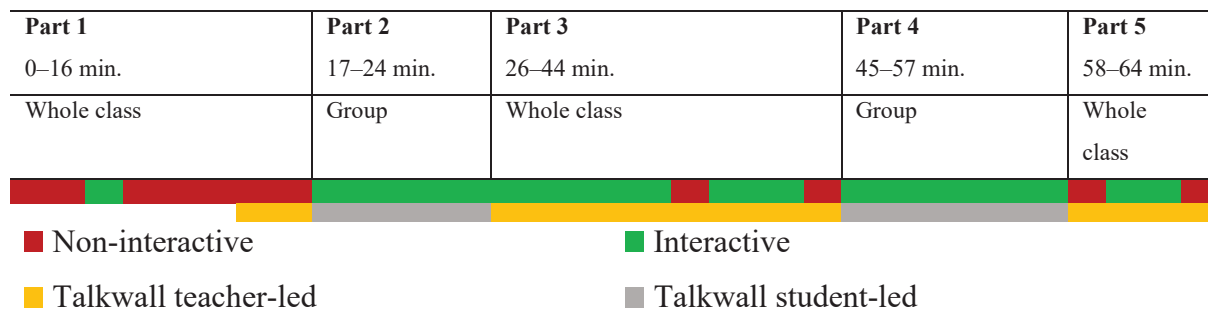
4.2 The lesson objectives and trajectory

The lesson analysed was on the topic of the Norwegian language, and the subject-specific objective was to identify the characteristics of different text genres and discuss the features of these genres in groups. In addition to the subject-specific objective, the goal was to raise the students' awareness of the agreed-upon talk rules to be followed during their interactions (Warwick et al., 2020).

Figure 2 is a timeline of the results of the minute-by-minute coding, representing the overall lesson trajectory. An example of the detailed coding of the lesson can be found in Appendix B. The learning activities throughout the lesson alternated between group and whole-

class interactions using Talkwall. As Figure 2 demonstrates, this lesson was more interactive than non-interactive, and Talkwall was used for almost the entire lesson during student-led and teacher-led activities.

Figure 2. Lesson timeline

Part 1 0–16 min.	Part 2 17–24 min.	Part 3 26–44 min.	Part 4 45–57 min.	Part 5 58–64 min.
Whole class	Group	Whole class	Group	Whole class

■ Non-interactive   ■ Interactive

■ Talkwall teacher-led   ■ Talkwall student-led

The actions performed by the teacher to make the purposes and practices of talk for learning relevant for the students varied throughout the lesson and the different activities. Through our thematic analysis, we identified multiple strategies that the teacher employed to explicitly address the talk rules, using different resources to make them relevant to the students in the context of microblogging activities. In the following we present a selection of the various strategies identified through the thematic analysis and examples of how the group of students picked these up during their interactions.

4.3 The lesson activities

4.3.1 Part 1: Introducing the learning objectives and modelling productive ways of talk

The teacher starts the lesson by introducing the learning objectives and the talk rules that the class had developed and agreed to follow prior to this lesson. The learning objective for the lesson is to raise the students' awareness about the agreed-upon talk rules, which the students are expected to pick up on during their interactions. In the current lesson, the teacher focuses on three talk rules: (1) asking for everyone's opinion, (2) discussing all alternatives before making conclusions and (3) looking at and listening to the person who is talking. A complete list of all the talk rules can be found in Appendix C. During the introduction of the current lesson, the teacher explains that the reasons for focusing on only three of the rules are (1) '*these three are especially important for today's activities*' and (2) it is '*too much to remember to focus on all six rules at once*'. In this excerpt we focus on the teacher, who is presenting the lesson objectives using different resources.

Excerpt 1

| Turn	Speaker	Talk and action
1	Teacher	Talking together allows us to learn in an extremely effective way.

The teacher emphasises that how students talk together is important for learning. Talk rules in the 'speech bubbles' are displayed on the bulletin board behind her.

| 2 | Teacher | That is what we want to focus on right now. We have Norwegian, and the objective for this lesson is this ((pointing to the whiteboard)). It is about language skills, how we talk together. | |

The teacher highlights the three talk rules, which are the focus of this lesson and displayed on the whiteboard.

| 3 | Teacher | And these ((walking towards the bulletin board and pointing to the talk rules displayed as speech bubbles)) are the ones we will focus on today. | |
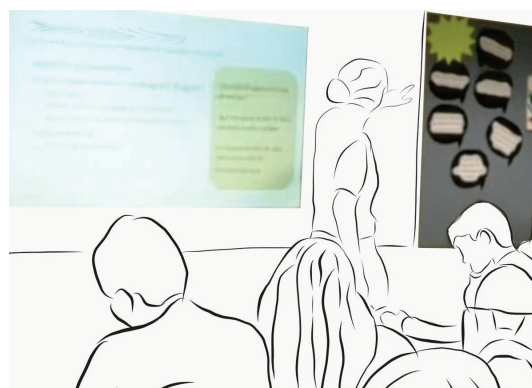
The teacher is pointing to the talk rules displayed as speech bubbles, emphasising the connection between the talk rules written on the speech bubbles and the conversation openers.

| 4 | Teacher | In order for everyone in the group to provide their opinion, it is important to remember the question, 'What do you think?' ((with repeated movement, pointing from speech bubble to the linked sentence opener)). | |
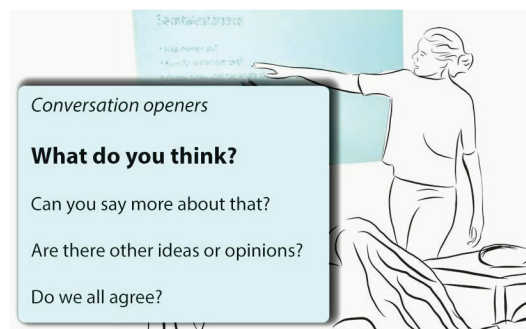
The teacher is highlighting the conversation openers on the whiteboard.

The excerpt begins with the teacher explicitly stating the reasons why talking together is important (Turn 1). She *reminds* the students about the agreed-upon talk rules and making

the practice of language skills a learning objective for the lesson (Turn 2). This is highlighted by the three talk rules that were selected and *displayed* on the whiteboard. The teacher also indicates that these three talk rules are the same as those that the class had agreed upon earlier (Turn 3). Next, the teacher presents the conversation openers to the students (Turn 4). Each of the conversation openers is then explicitly linked to the talk rules. The conversation openers are presented as questions to be asked to ensure that the talk rules are being followed.

This excerpt illustrates certain important aspects of how the teacher provides scaffolds for the students to use when they engage in discussions in their respective groups. First, we can see that the teacher uses multiple resources to direct the students' focus towards participating in talk for learning. She points out the three talk rules that are in focus, which were devised with the students and meant to scaffold the students by imposing certain constraints on their discussions, possibly leading to more focused discussions. The three talk rules are connected to specific conversation openers, which model how students can interact within their peer groups in productive ways. Through the use of multiple resources, the teacher demonstrates to the students what qualifies as talk for learning and models how they can manage this during their peer interactions.

4.3.2 Part 2: Asking everyone for their opinion – applying the conversation openers

Excerpt 2 is taken from the second part of the lesson. For this group activity the teacher hands out four texts representing different genres. The students are asked to identify the text genre and write their answers in Talkwall. In the excerpt the students discuss what characterises an autobiography. The excerpt begins immediately after a group of three students discussed the genre of the third text. Ally controls the iPad with Talkwall, Bella holds a copy of the printed text that they discuss, and Cory is seated between the girls. Ally and Bella participate in the discussion, while Cory remains quiet most of the time.
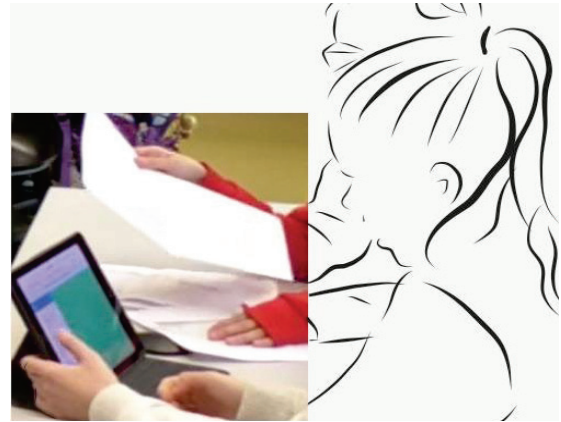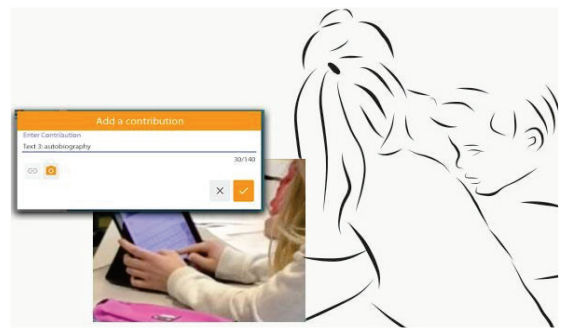
Excerpt 2

Turn	Speaker	Talk and action
1	Ally	Okay, let's begin with number three then ((opens Talkwall)).

Ally creates new contribution in Talkwall and starts to write.

Turn	Speaker	Talk and action
2	Bella	Number three. Uhm, autobiography ((finds the copy of text number three)).

Turn	Speaker	Talk and action
3	Ally	Text number three is an autobiography ((writing Talkwall contribution as she speaks)) (...). ((Stops abruptly and turns towards Cory.)) What do you think?

Ally stops writing on Talkwall and turns towards Cory.

This excerpt demonstrates one way that that the students picked up on the teacher's way of making relevant for the students how to talk together, which we see during the students' interactions with each other while using Talkwall. We see that Ally and Bella are talking and that Cory is relatively silent until Ally is about to contribute their collective answer to Talkwall (Turn 3). In fact, Cory has been silent for most of the group work until Ally is explicitly asking him to participate. The abrupt pause in Ally's writing on Talkwall seems to indicate that she remembered just then the requirement to ask everyone for their opinion before contributing to Talkwall.

Here, the talk rules and Talkwall are central resources. One talk rule that is the focus of this lesson is that everyone is asked for their opinion before they make their collective

contribution to Talkwall. Thus, part of the designed activity includes everyone, which Ally seems to remember before contributing their collective answer to Talkwall.
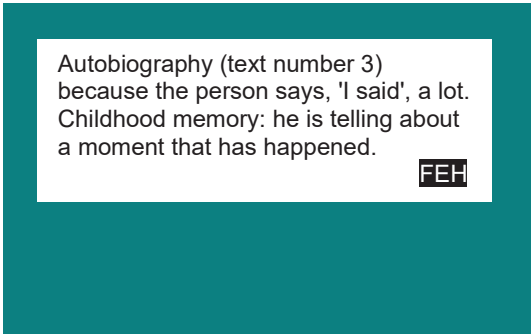
In the establishment of a dialogic classroom ethos, talk rules can be fundamental, but they require time and support to become embedded in the classroom. Here, we see how the talk rules and the conversation openers are picked up by the students, how their interactions are scaffolded by these learning resources and how the talk rules themselves guide the students in their ways of talking together. The conversation openers are an important resource, scaffolding the students' interactions by modelling specific ways that the students can talk. When Ally asks Cory for his opinion, we can see that she uses one of the provided conversation openers to try to involve him in the group's sharing of ideas. Moreover, integrated into the activity design is the objective that everyone is asked for their opinion before the group contributes to Talkwall. This is scaffolding the students' group interactions in the form of the teacher's vicarious presence (Warwick et al., 2010), reminding the students of the importance of asking everyone.

4.3.3 Part 3: Focusing on differences

In this third part of the lesson, the teacher and students discuss the students' Talkwall contributions from their group work. The teacher selects the groups' contributions and displays them on the teacher's Talkwall. In the following excerpt the right column contains the contributions on the teacher's wall in front of the class. The group nicknames are in the bottom right corner of the contribution (see Appendix D for a representation of the placement on the Talkwall screen).

Excerpt 3

Turn	Speaker	Talk and action
1	Teacher	Yes, everyone has contributed, and it is a bit funny to see, because you are different groups and different people, so it looks different.
2	Adam	Yes, and no one has the same!
3	Teacher	No.
4	Adam	Everyone has their own way of writing.

Autobiography (text number 3) because the person says, 'I said', a lot. Childhood memory: he is telling about a moment that has happened.
FEH

5	Teacher	Mm (...)... Autobiography. It's number three, that is, autobiography. This group here ((the teacher walks towards Talkwall and points to a group post)). F, E and H. Frederick, Emma and Hermione. What was it that was the evidence here ((pointing to the post))? And now it's important to listen to them. What was the evidence here? ((Points to the group post.))
6	Frederick	Uh, he said a lot, I said. And told a moment that has happened – had happened.
7	Teacher	Yes? Told a moment that had happened?
8	Frederick	Yes.
9	Teacher	And what was the moment?
10	Frederick	A childhood memory.
11	Teacher	Yes. Great. It's... We see in a way that everyone here has written 'childhood memory' ((points to posts on Talkwall)). And then, what else is it that you have written here? Are there others who have something else?

Nr. 4 = reader's letter (catchy headings). Nr. 1 = biography (facts about a famous person). Nr 3 = autobiography (first person). Nr 2 = short story
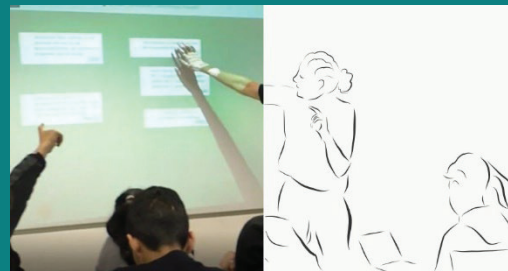
3- Autobiography: About a childhood memory. You get to know his thoughts. Using words like 'I', 'has' and 'have'. It means that it happened.
JAPP

Text number 3 is an autobiography because there are childhood memories.
SNICKERS

1 is a biography, 2 is a short story, 3 is an autobiography, and 4 is a reader's letter.

In this excerpt, the teacher comments on the differences between the Talkwall contributions and observes that they reflect the different discussions in the peer groups. Adam spontaneously confirms the teacher's comment, adding that 'no one has the same!' and that *everyone* has different ways of writing their contributions (Turns 2 and 4). The teacher agrees by nodding, saying 'Mm (...)' (Turn 5) and pausing briefly. Then she continues by asking the group called FEH to elaborate on their contribution and reminding the students about one of the talk rules in focus (as demonstrated in Excerpt 1), namely, *to listen to each other* (Turn 5). Frederick attempts to explain what the evidence for their answer on Talkwall is (Turns 6 and 8). With the teacher's prompting (Turn 7), he says that the evidence they found, supporting why they think the text is an autobiography, is that the text contained a childhood memory. The teacher then points out that other groups also wrote 'childhood memory' before she asks for alternatives.

One of the talk rules in this lesson is to discuss alternatives. In this excerpt we see the teacher highlighting that the students have contributed different answers to Talkwall. By promoting differences as being natural because they are different people, she lets the students know that their different opinions are welcome. By clearly demonstrating variety for the students before she asks for other opinions (Turn 11), she is trying to open up a dialogic space by welcoming multiple opinions and possibilities. Also, in this excerpt we can see that differences seem to become evident to the students. As Adam notices in Turns 2 and 4, it seems as if he recognises the variety of the students' Talkwall contributions. This is interesting, as it demonstrates the collective space that Talkwall represents. Furthermore, we see the importance of the teacher here, as she holds a privileged role in guiding the conversations. Through her modelling of how to attend to the content in Talkwall, she scaffolds the students' way of listening and talking together as well as embracing differences and diverse opinions. This is an important contribution to developing a dialogic classroom ethos.
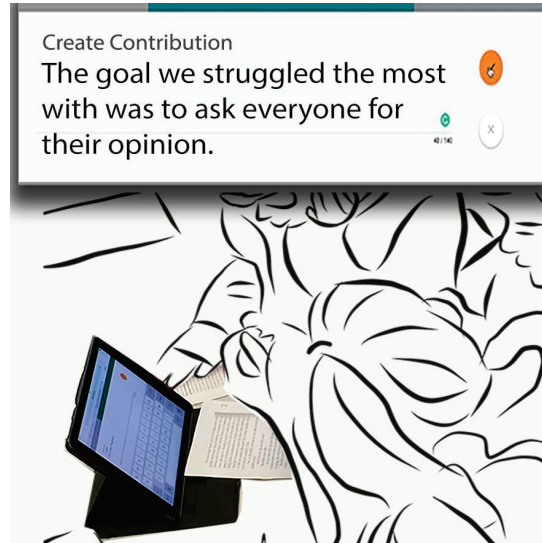
4.3.4 Part 4: Talk about talk

The next excerpt is taken from the fourth part of the lesson. The task is a meta-reflection about how the student groups interacted during the group activity. Here, the students are discussing what they found difficult during their group talks. During this activity the group receives advice through Talkwall and gives advice to another group through Talkwall by editing a contribution and hashtagging this with #advice. The excerpt starts with a group of three making their contribution to Talkwall. For most of the lesson, both during the group and whole-class activities, Cory was silent.

Excerpt 4

Turn	Speaker	Talk and action
1	Ally	It is difficult to remember to ask everyone (...) um. ((Writes contribution in Talkwall.))

Create Contribution
The goal we struggled the most with was to ask everyone for their opinion.

Ally writes a new Talkwall contribution, and Bella reads it out loud. Cory looks at the iPad with Talkwall.

Turn	Speaker	Talk and action
2	Bella	((Reading the contribution in Talkwall.)) *Ask everyone for their opinion.*
3	Ally	((Scrolling through the Talkwall feed.))
4	Bella	((Reads contributions from the Talkwall feed as Ally is scrolling.)) *It is difficult to remember to ask everyone.*
5	Ally	That is ours! ((Points to their contribution in the feed.))

| 6 | | ((Reads the contribution with the hashtag added by another group)) *Take turns within the group to let everyone talk.* Yes, that is a good idea. |
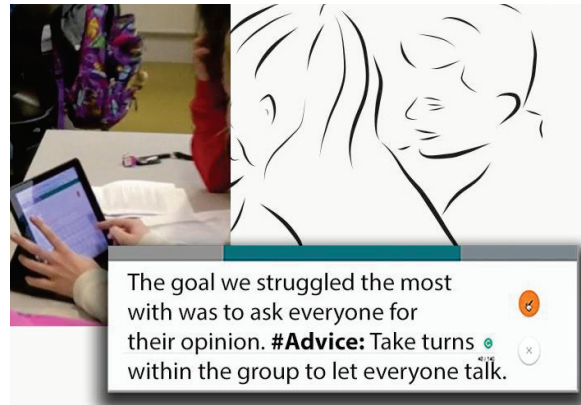
The group's contribution with the hashtagged advice from another group. Cory smiles when he sees their contribution and the advice.

| 7 | Ally | That's smart. Thank you! ((Shouts across the room to the other group.)) |

In this excerpt, we see the group making their contribution to Talkwall. The group has written a short summary of what they found most difficult with following the talk rules they were supposed to adhere to during the lesson. Next, Bella reads their contribution aloud before Ally posts it to the Talkwall feed. Then, Ally starts scrolling through the feed, and both Ally and Bella appear to be reading the other groups' contributions. Bella reads their own contribution out loud, and Ally notices that their contribution has been hashtagged and has received advice from another group. Cory is silent during this exchange but nods and smiles when Bella reads the advice aloud. Ally says that the advice is smart and shouts, 'Thank you!', to the group across the classroom who wrote the advice.

This excerpt illustrates how the teacher explicitly focused on the students' group discussions on a metalevel. The students' discussion in this excerpt focuses on not only the topic being studied but also the students' ways of talking to each other. The explicit focus on talk for learning is made even more evident by the students' engagement in reflections about the other students' ways of talking and by encouraging them to advise each other. Cory is silent throughout most of the lesson, except when the two girls encourage him to take part in the discussion. This is also demonstrated in Excerpt 2. However, he does seem to follow the activity on Talkwall because he looks at the shared iPad and reacts to and shows interest in the advice they received on their Talkwall contribution.

The excerpt illustrates how the teacher employs an activity of metatalk about the talk rules as a way of explicitly focusing on and modelling for each other how students could communicate in a manner that is beneficial to learning. She also asks the students to advise each other about how they managed to use the talk rules during their group discussion. The students thus reflect on their own performance in various ways. First, they are thinking together about how they could use their experiences from their group talks to advise others. Second, they receive advice from other groups. Talkwall makes this possible through microblogging contributions. Through the feed, the students could immediately read, edit and hashtag other groups' advice, which makes simultaneous engagement in other groups' discussions possible for all the students in the class. This way of discussing, by using co-located microblogging, is situated in what can be called a joint zone of proximal development, in which the design of the activity, the teacher, and the language and material resources provide scaffolds for the students' development of talk for learning.

4.3.5 Part 5: Sharing students' advice

The last excerpt is taken from the fifth part of the lesson, and the teacher has pinned all the groups' contributions onto her Talkwall, which is displayed to the whole class.

Excerpt 5

Turn	Speaker	Talk and action
1	Teacher	I want to read all the good advice. You need to have 'big ears'. Listen.
2	Teacher	Yes. ((Pointing to and reading Talkwall contributions from the teacher wall.)) *The goal we struggled the most with was to ask everyone for their opinions. And advice* (...).

3	Teacher	((Reads more contributions.))

The teacher is displaying Talkwall with the pinned contributions. The teacher reads all the students' contributions.

4	Teacher	I think the next time we have a group task, this ((pointing to Talkwall with student contributions)) will serve as our idea board. This will be a good point to come back to and ((can function)) as a reminder to ourselves about what good advice we already have.

The teacher starts this part of the lesson by reminding the students about the importance of listening. The fact that she is pointing to a specific Talkwall contribution indicates that she intends to have the students pay attention to this contribution. The illustration in this excerpt demonstrates what the Talkwall looks like when the teacher has pinned all the students' contributions to the wall and highlights a specific contribution by pointing to it. The teacher reads aloud the group's contribution and the advice that the other group provided for them. The teacher then points out that *all* the students' ideas and advice for each other are things they will need for similar activities in future lessons as reminders of how to engage in talk for learning (Turn 3).

This brief excerpt shows some of the important functionalities enabled by co-located microblogging. First, the teacher gains access to all the students' contributions and can distribute them to the whole class. Furthermore, she can use Talkwall to create a collective

scaffold that can support the students' engagement in talk for learning, which is more permanent than just oral metatalk and reflection. Thus, Talkwall enables the students to turn to the collectively made scaffold for advice during future lessons, as demonstrated in Excerpt 5. Moreover, the teacher recognises the value of differences (demonstrated in Excerpt 3) and the importance of each student's ideas, as the co-constructed Talkwall contains the students' own perspectives, which acknowledge both their difficulties about group talk and their advice to each other.

In the following lesson, the teacher starts by bringing forward the specific Talkwall contributions from Excerpt 5, reminding the students how to engage in talk for learning. In this way, Talkwall becomes a semi-permanent and collective scaffold that could be part of a longer learning trajectory. This teacher demonstrates how to start building a dialogic classroom ethos by using a variety of strategies. Both language resources and material resources become part of the activities and thus provide scaffolds for both group and whole-class dialogues.

Our analysis of excerpts 1–5 demonstrates how the teacher uses Talkwall, together with other resources during the lesson, to scaffold students' talk for learning and the students' uptake of this. The teacher first activates the shared class resources and the conversation openers, scaffolding the students' talk by focusing the students on a specific way of talking together to learn. She also models specific talk patterns, using conversation openers and welcoming differences. The students' uptake of this can be seen in Excerpts 2 and 4, in which they use these conversation openers during their group talks. The microblogging tool enables a wider discussion, with more voices being heard than would otherwise be possible within a small group. Our analysis demonstrates how implementing a microblogging technology such as Talkwall provides a new setting for contributing ideas. It further illustrates how this technology mediates these contributions and becomes a collective scaffold for talk for learning.

5. Discussion and conclusion

In line with our research questions, Table 1 summarises this lesson, including our detailed observations about how the teacher was making explicit to her students what counts as talk for learning and how her strategies helped maintain the relevance of the talk rules throughout the lesson.

Table 1

Five ways that the teacher made talk for learning relevant to the students

1. Displaying representations of productive ways of talking together.	• Displaying the talk rules on permanent posters. • Displaying conversation openers during activities. • Collecting and displaying students' advice to each other on Talkwall – also for further use.
2. Giving explicit reminders about the rules in the activity.	• Focusing on three (or two) specific rules suitable for the specific microblogging activity. • Presenting the talk rules on permanent wall posters and connecting them to conversation openers. • Giving explicit reminders about the importance of listening.
3. Inviting all students to contribute.	• Encouraging all students to contribute to Talkwall and group and whole-class interactions by focusing on the talk rule, 'Ask everyone for their opinion', and specifying the talk rule in the context of Talkwall by adding 'before contributing to Talkwall'. • Welcoming different opinions. • Encouraging all students to share their ideas with the group and the whole class, both face-to-face and through Talkwall.
4. Integrating the talk rules into the learning activity.	• Encouraging students to ask and listen to every group member for their opinions and reaching a consensus before contributing to Talkwall (as part of the activity). • Encouraging students to engage other groups' Talkwall contributions to 'listen' to more of their peers.
5. Encouraging meta-reflection on group interactions.	• Engaging students in talk about the talk rules themselves or about their experience in their peer interactions. • Engaging students in a Talkwall activity in which they reflect on and advise each other about the talk rules.

Further, we show the students' uptake and how they engaged with their peers' contributions through both face-to-face oral interactions and microblog contributions. The students' learning, about both the substantive topic of the lesson and talking together, was supported by Talkwall and the resources applied in their interactions; these resources were coordinated by the teacher. Access to classmates' contributions in Talkwall allowed more perspectives and different ideas to be shared during the students' interactions.

To engage students in talk for learning, the classroom ethos is fundamental, and it is important that the teacher focus on establishing a *dialogic* classroom ethos. As other studies have shown, simply creating talk rules with the students does not mean that the students will

start following them. The students need guidance and advice, and the talk rules must be meaningfully integrated with classroom tasks and activities when working towards the establishment of a dialogic classroom ethos (Warwick et al., 2020). One of the ways in which the teacher in our study worked to develop such an ethos was by integrating the talk rules with microblogging learning, activities and tasks, as demonstrated in Excerpts 1–5. Thus, the talk rules were utilised as a collective resource that modelled for the students how to talk together in peer groups. By integrating talk rules and ways of talking together into the activity, the students' talk was also scaffolded without the teacher's physical presence during the group talk (Warwick et al., 2013). This finding is important because it points out why it is crucial to integrate talk rules with classroom tasks and tools (Lund & Rasmussen, 2008) and how the design of an activity also has a scaffolding function (Cazden, 2001).

It is crucial to emphasise that teaching by using microblogging or other digital tools can move in any direction. Bringing digital technology into the classroom can change how students interact with each other and how teachers interact with their students (Staarman, 2009). In our case, the students interacted through both written and oral dialogues, mediated by microblogging technology. Although in this lesson the teacher did not specifically focus on how the students should write their Talkwall contributions, the talk rules provided the students with important guidelines for how to interact orally and with the written microblogs on Talkwall during the group activities. For instance, Excerpt 3 demonstrates how the teacher focuses on the differences between the students' written contributions, thus making variety something to strive for. Moreover, the meta-reflection activity (Excerpts 4 and 5) requires students to read and interact with each other's microblogs, thus modelling a way of productive engagement in a digital collective space. The oral interactions in Excerpts 2 and 4 demonstrate the students' uptake of what the teacher focused on as relevant for talk. One student group, in particular, applies the conversation openers and reflects on their peer interactions. Specifically, in Excerpt 2, the talk rule – that the students need to discuss alternatives before making a contribution to Talkwall – is picked up in the group interaction. Here, the provided conversation openers become an important resource during the group's attempts to include Cory. However, this example also demonstrates difficulties that students encounter when engaging in group discussions, such as getting everyone to participate. In the lesson, the silent student Cory does not take part in the oral discussion beyond the two times that he participates at the girls' encouragement, regardless of the fact that a lesson objective is to involve everyone in group talk. Our study represents an important empirical finding regarding the role of

technology, microblogging in our case, when focusing on productive ways of talking together and meeting difficulties such as the lack of participation in the oral discussion. As our example shows, Cory does, in fact, pay attention to Talkwall and the contributions of both his group and the other groups. This finding demonstrates the possible value of a resource such as Talkwall to students who otherwise do not participate much orally. Microblogging provides the students with a collective object that can, when used with a dialogic intention, focus the students' attention, even though they do not participate orally, on different perspectives and ideas, which is crucial to the development of a dialogic classroom ethos.

The new format of complementary oral and written talk created by microblogging, which includes an open and public space where students' short contributions are displayed, focuses the teacher and students on using metatalk in the reflective Talkwall activity. As illustrated in Excerpt 4, the students' group talk represents an uptake of the practices appropriate to talk for learning and focuses on their ways of talking to each other. This explicit focus on the metalevel of talk for learning is made even more evident by the students, who engage in their classmates' reflections in Talkwall and advise each other. Here, microblogging served as a space for collecting metatalk comprised of the students' reflections on how to talk in a way beneficial for learning.

This study demonstrates how one teacher scaffolds talk for learning and how Talkwall becomes a collective scaffold for this purpose. Through a 'storyline' presentation of the lesson, we provide visual representations of the interactions between students, including multimodal resources, which, as mentioned earlier, have their challenges (Candela et al., 2004). We provide an analysis of what this interactional work looks like in technology-rich and multimodal classrooms and consider several aspects of implementation, including digital technology, resources, the complex interactions between students and teachers, and the role of technology. These multimodal excerpts aim to illustrate incidents that took place in realistic settings while following relevant anonymisation regulations. We believe that this form of representation can provide clarity about ongoing interactions and therefore methodologically contribute to research on learning and social interaction.

The study offers an updated approach that integrates the classic concept of scaffolding and how one might use new technology to scaffold talk for learning to develop a dialogic classroom ethos. In the presented study, the teacher uses talk rules to make explicit what qualifies as talk for learning to the students in the context of co-located microblogging, and scaffolds the students' talk by providing appropriate resources such as conversation openers.

In this way, the students are encouraged and supported when they participate in peer discussions. Hence, during these discussions, the students are provided with opportunities to express themselves and their different ideas, to think collectively and to construct new knowledge together, which is central for the establishment of a dialogic classroom ethos (Mercer & Littleton, 2007; Wells, 2009).

Our empirical finding demonstrates the central role that Talkwall plays in peer group interactions. The combination of face-to-face and technology-mediated interactions enabled mutual engagement in thinking together as the digital space collected all the users' contributions, making it a dialogic space (Pifarré & Li, 2018). Here, Talkwall provides a space and a collective scaffold where the students gain immediate access to others' ideas and the opportunity to edit and contribute advice to each other. Moreover, the students were able to give advice and distribute this to the whole class through Talkwall as well as share their ideas both within and beyond their group. Thus, the microblogging technology made students' thinking visible to other participants and enabled new possibilities for engaging in whole-class discussions and peer group interactions. Such increased participation has also been found in other studies that use microblogging tools (Frøytlog & Rasmussen, 2020; Rasmussen & Hagen, 2015). Furthermore, as Talkwall brought the contributions from the peer discussion to other groups as well as the whole-class discussion, we can assume that most of the students, at least indirectly, shared their ideas with each other, which was one of the talk rules focused on in this lesson. Also, the students shared advice, results and experiences from their group interactions, both in Talkwall and face-to-face, with students beyond their groups.

Furthermore, our empirical analysis demonstrates that making talk rules explicit requires continuous scaffolding from the teacher and can be both complex and time-consuming. It is worth noting that time and complexity have also been considered likely factors contributing to the lack of explicit teaching of talk rules in other studies that have investigated dialogic teaching strategies on a large scale (Howe et al., 2019). As others have argued, the explicit focus on how to talk together to learn usually goes beyond curricular goals and therefore reduces the amount of time available for teaching subject-specific topics (Park et al., 2017). Considering the learning benefits of adopting a more dialogic classroom ethos, such as better performance in terms of critical thinking and collaborative problem-solving, which are important for both school learning and participation in society (Howe & Abedin, 2013; Kuhn, 2015; Lawrence & Snow, 2010; Mercer, 2013), more attention should be paid to assisting

teachers with task design that integrates work related to, for instance, making talk rules relevant for the students as a way of developing talk skills that promote learning.

6. References

Alexander, R. J. (2020). *A dialogic teaching companion.* Routledge.

Barnes, D. (1976). *From communication to curriculum.* Penguin.

Blikstad-Balas, M. (2015). Digital literacy in upper secondary school – What do students use their laptops for during teacher instruction? *Nordic Journal of Digital Literacy*, *10*(Jubileumsnummer), 122–137. https://doi.org/10.18261/issn1891-943x-2015-jubileumsnummer-09

Boyd, M. P., & Markarian, W. C. (2011). Dialogic teaching: Talk in service of a dialogic stance. *Language and Education, 25*(6), 515–534. https://doi.org/10.1080/09500782.2011.597861

Bruner, J. (1978). The role of dialogue in language acquisition. *The Child's Conception of Language*, 241–256.

Candela, A., Rockwell, E., & Coll, C. (2004). What in the world happens in classrooms? Qualitative classroom research. *European Educational Research Journal, 3*(3), 692–713. https://doi.org/10.2304/eerj.2004.3.3.10

Cazden, C. B. (2001). *Classroom discourse: The language of teaching and learning* (2nd ed., Vol. 18). Heinemann. https://linkinghub.elsevier.com/retrieve/pii/0346251X9090014V

Derry, S. J., Pea, R. D., Barron, B., Engle, R. A., Erickson, F., Goldman, R.,... & Sherin, B. L. (2010). Conducting video research in the learning sciences: Guidance on selection, analysis, technology, and ethics. *The Journal of the Learning Sciences, 19*(1), 3–53. https://doi.org/10.1080/10508400903452884

de Sousa, F., & Rasmussen, I. (2019). Productive disciplinary engagement and videogames. *Nordic Journal of Digital Literacy, 14*(3–4), 99–116. https://doi.org/10.18261/issn.1891-943x-2019-03-04-02

Fernández, M., Wegerif, R., Mercer, N., & Rojas-Drummond, S. (2002). Re-conceptualizing 'scaffolding' and the zone of proximal development in the context of symmetrical collaborative learning. *The Journal of Classroom Interaction*, *36/37*(2/1), 40–54. https://www.jstor.org/stable/23869224

Gilje, Ø., Ingulfsen, L., Dolonen, J. A., Furberg, A., Rasmussen, I., Kluge, A.,... & Granum, K. (2016). Med ARK&APP. Bruk av læremidler og ressurser for læring på tvers av arbeidsformer. Universitetet i Oslo.

Hennessy, S., & Davies, M. (2019). Teacher professional development to support classroom dialogue: Challenges and promises. In N. Mercer, R. Wegerif, & L. Major (Eds.), *The Routledge International Handbook of Research on Dialogic Education* (pp. 238–253). Routledge. https://doi.org/10.4324/9780429441677

Howe, C. (2021). Strategies for supporting the transition from small-group activity to student learning: A possible role for beyond-group sharing. *Learning, Culture and Social Interaction, 28*, 100471. https://doi.org/10.1016/j.lcsi.2020.100471

Howe, C., & Abedin, M. (2013). Classroom dialogue: A systematic review across four decades of research. *Cambridge Journal of Education, 43*(3), 325–356. https://doi.org/10.1080/0305764x.2013.786024

Howe, C., Hennessy, S., Mercer, N., Vrikki, M., & Wheatley, L. (2019). Teacher–student dialogue during classroom teaching: Does it really impact on student outcomes? *Journal of the Learning Sciences, 28*(4–5), 462–512. https://doi.org/10.1080/10508406.2019.1573730

Kershner, R., Hennessy, S., Wegerif, R., & Ahmed, A. (2020). *Research methods for*

educational dialogue. Bloomsbury.

Kim, M. Y., & Wilkinson, I. A. (2019). What is dialogic teaching? Constructing, deconstructing, and reconstructing a pedagogy of classroom talk. *Learning, Culture and Social Interaction*, *21*, 70–86. https://doi.org/10.1016/j.lcsi.2019.02.003

Kuhn, D. (2015). Thinking together and alone. *Educational Researcher, 44*(1), 46–53. https://doi.org/10.3102/0013189x15569530

Lantz-Andersson, A. (2016). Embracing social media for educational linguistic activities. *Nordic Journal of Digital Literacy, 10*(1), 50–77. https://doi.org/10.18261/issn.1891-943x-2016-01-03

Lawrence, J. F., & Snow, C. E. (2010). Oral discourse and reading. In M. L. Kamil, P. D. Pearson, E. Birr Moje, & P. Afflerbach (Eds.), *Handbook of Reading Research* (Vol. IV, pp. 320–337). Routledge. https://doi.org/10.4324/9780203840412

Littleton, K., & Mercer, N. (2013). *Interthinking: Putting talk to work* (1st ed.). Routledge. https://doi.org/10.4324/9780203809433

Ludvigsen, S. R., Lund, A., Rasmussen, I., & Säljö, R. (Eds.). (2010). Learning across sites: New tools, infrastructures and practices. Routledge.

Major, L., Warwick, P., Rasmussen, I., Ludvigsen, S., & Cook, V. (2018). Classroom dialogue and digital technologies: A scoping review. *Education and Information Technologies, 23*(5), 1995–2028. https://doi.org/10.1007/s10639-018-9701-y

Mercer, N. (2004). Sociocultural discourse analysis: Analysing classroom talk as a social mode of thinking. *Journal of Applied Linguistics*, *1*(2), 137–168. https://doi.org/10.1558/japl.v1.i2.137

Mercer, N. (2008). The seeds of time: Why classroom dialogue needs a temporal analysis. *Journal of the Learning Sciences, 17*(1), 33–59. https://doi.org/10.1080/10508400701793182

Mercer, N. (2019). *Language and the joint creation of knowledge: The selected works of Neil Mercer.* Routledge.

Mercer, N., & Dawes, L. (2014). The study of talk between teachers and students, from the 1970s until the 2010s. *Oxford Review of Education, 40*(4), 430–445. https://doi.org/10.1080/03054985.2014.934087

Mercer, N., Hennessy, S., & Warwick, P. (2019). Dialogue, thinking together and digital

technology in the classroom: Some educational implications of a continuing line of inquiry. *International Journal of Educational Research, 97*, 187–199. https://doi.org/10.1016/j.ijer.2017.08.007

Mercer, N., & Littleton, K. (2007). *Dialogue and the development of children's thinking: A sociocultural approach* (1st ed.). Routledge. https://doi.org/10.4324/9780203946657

Mercer, N., Wegerif, R., & Dawes, L. (1999). Children's talk and the development of reasoning in the classroom. *British Educational Research Journal, 25*(1), 95–111. https://doi.org/10.1080/0141192990250107

Mercier, E., Rattray, J., & Lavery, J. (2015). Twitter in the collaborative classroom: Micro-blogging for in-class collaborative discussions. *International Journal of Social Media and Interactive Learning Environments, 3*(2), 83–99. https://doi.org/10.1504/ijsmile.2015.070764

Michaels, S., O'Connor, C., & Resnick, L. B. (2008). Deliberative discourse idealized and realized: Accountable talk in the classroom and in civic life. *Studies in Philosophy and Education, 27*(4), 283–297. https://doi.org/10.1007/s11217-007-9071-1

Mortimer, E., & Scott, P. (2003). *Meaning making in secondary science classrooms.* Open University Press.

Muhonen, H., Pakarinen, E., Poikkeus, A.-M., Lerkkanen, M.-K., & Rasku-Puttonen, H. (2018). Quality of educational dialogue and association with students' academic performance. *Learning and Instruction, 55*, 67–79. https://doi.org/10.1016/j.learninstruc.2017.09.007

Omland, M., & Rødnes, K. A. (2020). Building agency through technology-aided dialogic teaching. *Learning, Culture and Social Interaction, 26*, 100406. https://doi.org/10.1016/j.lcsi.2020.100406

Park, J., Michaels, S., Affolter, R., & O'Connor, C. (2017). Traditions, research, and practice supporting academically productive classroom discourse. *Oxford Research Encyclopedia of Education.* https://doi.org/10.1093/acrefore/9780190264093.013.21

Pifarré, M., & Li, L. (2018). Characterizing and unpacking learning to learn together skills in a wiki project in primary education. *Thinking Skills and Creativity, 29*, 45–58. https://doi.org/10.1016/j.tsc.2018.06.004

Rasmussen I. (2012) Trajectories of participation – Temporality and learning. In: N. M. Seel (ed.), *Encyclopedia of the Sciences of Learning.* Springer. 3334-3337 https://doi.org/10.1007/978-1-4419-1428-6_724

Rasmussen, I., & Hagen, Å. (2015). Facilitating students' individual and collective knowledge construction through microblogs. *International Journal of Educational Research, 72*, 149–161. https://doi.org/10.1016/j.ijer.2015.04.014

Rasmussen, I., & Ludvigsen, S. (2010). Learning with computer tools and environments: A sociocultural perspective. *International Handbook of Psychology in Education*. Emerald. 399–433.

Rasmussen, I., & Smørdal, O. (2016). Talkwall. https://talkwall.uio.no/#/

Säljö, R. (2018). Symboliska teknologier och lärande i en digital tid. *Pedagogisk Forskning i Sverige, 23*(5), 168–183. https://doi.org/10.15626/pfs23.5.10

Sana, F., Weston, T., & Cepeda, N. J. (2013). Laptop multitasking hinders classroom learning for both users and nearby peers. *Computers & Education, 62*, 24–31. https://doi.org/10.1016/j.compedu.2012.10.003

Staarman, J. K. (2009). The joint negotiation of ground rules: Establishing a shared collaborative practice with new educational technology. *Language and Education*, *23*(1), 79–95. https://doi.org/10.1080/09500780802152796

Twiner, A., Littleton, K., Whitelock, D., & Coffin, C. (2021). Combining sociocultural discourse analysis and multimodal analysis to explore teachers' and pupils' meaning making. *Learning, Culture and Social Interaction, 30*, 100520. https://doi.org/10.1016/j.lcsi.2021.100520

Vrikki, M., Wheatley, L., Howe, C., Hennessy, S., & Mercer, N. (2019). Dialogic practices in primary school classrooms. *Language and Education*, 33(1), 85-100, https://doi.org/10.1080/09500782.2018.1509988

Warwick, P., Cook, V., Vrikki, M., Major, L., & Rasmussen, I. (2020). Realising 'dialogic intentions' when working with a microblogging tool in secondary school classrooms. *Learning, Culture and Social Interaction, 24*, 100376. https://doi.org/10.1016/j.lcsi.2019.100376

Warwick, P., Mercer, N., & Kershner, R. (2013). 'Wait, let's just think about this': Using the interactive whiteboard and talk rules to scaffold learning for co-regulation in collaborative science activities. *Learning, Culture and Social Interaction, 2*(1), 42-51. https://doi.org/10.1016/j.lcsi.2012.12.004

Warwick, P., Mercer, N., Kershner, R., & Staarman, J. K. (2010). In the mind and in the

technology: The vicarious presence of the teacher in pupil's learning of science in collaborative group activity at the interactive whiteboard. *Computers & Education, 55*(1), 350–362. https://doi.org/10.1016/j.compedu.2010.02.001

Wegerif, R., & Major, L. (2019). Buber, educational technology, and the expansion of dialogic space. *AI & Society, 34*(1), 109–119. https://doi.org/10.1007/s00146-018-0828-6

Wells, G. (2009). *The meaning makers: Learning to talk and talking to learn* (2nd ed.). Multilingual Matters.

Wertsch, J. V. (1998). *Mind as action.* Oxford University Press.

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving*. *Journal of Child Psychology and Psychiatry*, *17*(2), 89–100. https://doi.org/10.1111/j.1469-7610.1976.tb00381.x

Appendix A

Description of the detailed minute-by-minute coding, turn-by-turn coding and thematic categorisation of the lesson

The video-recorded lessons were analysed in different phases by the team of researchers involved in the DiDiAC project. All records of the various phases of analytical work were recorded in Microsoft Excel sheets for each individual video-recorded lesson.

First, we developed detailed descriptions of the classrooms and the schools to provide an account of the general context. This level of analysis drew upon field notes and lesson plans in addition to the video recordings. Each lesson was then analysed on a minute-by-minute basis by at least two research members. [2] This categorisation incorporated the participant structure (i.e. whole class, individual work and group work), the level of interactivity (i.e. non-interactive or interactive; Mortimer & Scott, 2003), and the use of Talkwall, whether the teacher's discussion of contributions on the shared screen or the student's discussions and contributions through their devices (i.e. teacher-led or student-led).

Second, we conducted a turn-by-turn deductive analysis of spoken dialogue during whole-class interactions when Talkwall was being used. In this phase we used transcribed data from the video-recorded lessons to provide a detailed coding of dialogue structures. This detailed coding focused on six categories of productive turns (i.e. invite elaboration, elaboration, invite reasoning, reasoning, querying and coordination) adapted from the 'Cambridge Dialogue Analysis Scheme' (CDAS; Vrikki et al., 2018). A more thorough description of the analytical procedures of the first two phases can be found in Major et al. (2022).

---

[2] Codes were assigned if more than half a minute (i.e. >30 seconds) features a particular code (Major et al., 2022).

Appendix B
Examples of the different phases of the analysis

LESSON PART 3	Content	Resources	Talkwall activity	Themes (categorised in NVivo)	Minute	Class	Group	Interactive	Non-interactive	Talkwall (T-Led)	Talkwall (S-Led)	Invite elaboration	Elaboration	Invite reasoning	Reasoning (RE)	Querying	Coordination
	The teacher and students discuss the students' Talkwall contributions.	Talk rules	The teacher displays the students' contributions.		30	■		■		■		1		1	4		
				Reminding	31	■		■		■		2	2		2		1
					32	■		■		■		1			3		
				Reminding	33	■		■		■		2	2	1			
					34	■		■		■		1		1	3		
					35	■				■			4		1		
					36	■			■	■		1			1		
					37	■			■	■		1	2		1		
					38	■		■		■					3		
				Inviting	39	■		■		■		1	2		2		
					40		■	■				1	2		1	2	
					41		■	■				1		2	2	1	1

Participant structure coded minute-by-minute.

Productive turns – Originally coded turn-by-turn. Modified here to demonstrate the *number* of productive turns *within* one minute.

A modified version of the Excel Spreadsheet integrated with the NVivo 12 coding. The example stems from part three of the lesson in the current article and represents the different levels of analysis.

Appendix C

Complete list of talk rules in the in the case study

- Ask everyone for their opinion.
- The group discusses all alternatives before making a decision.
- Look at and listen to the person who is talking.
- Prepare to change your mind, which means that you are listening to good arguments.
- Show respect for others' opinions.
- Ask questions if you think someone's explanations are not good enough.

Appendix D

Short story? Autobiography? Reader's letter? Biography?

Text number 3 is an autobiography because there are childhood memories.

SNICKERS

Nr. 4 = reader's letter (catchy headings). Nr. 1 = biography (facts about a famous person). Nr 3 = autobiography (first person). Nr 2 = short story

DAIM

1 is a biography, 2 is a short story, 3 is an autobiography, and 4 is a reader's letter.

TWIX

Autobiography (text number 3) because the person says, 'I said', a lot. Childhood memory: he is telling about a moment that has happened.

FEH

3. Autobiography: About a childhood memory. You get to know his thoughts. Using words like 'I', 'has' and 'have'. It means that it happened.

JAPP

ARTICLE 3

#Fact or #opinion: the educational design of a microblogging activity intended to engage students in productive interactions

Anja Amundrud, Ole Smørdal & Ingvill Rasmussen

Published online: 21 Oct 2021.

Submit your article to this journal ⬈

Article views: 655

View related articles ⬈

View Crossmark data ⬈

Routledge
Taylor & Francis Group

#Fact or #opinion: the educational design of a microblogging activity intended to engage students in productive interactions

Anja Amundrud [ID], Ole Smørdal [ID] and Ingvill Rasmussen [ID]

Department of Education, University of Oslo, Oslo, Norway

ABSTRACT

Educational activities using microblogging co-located with face-to-face communication might promote productive classroom interactions. However, much depends on how teachers design those activities. This article explores how the educational design of an activity that uses microblogging engages lower secondary school students in classroom interactions that are productive for learning. It presents a study of one teacher's educational design in which students (aged 12–13) in a Norwegian classroom use microblogging to explore distinctions between facts and opinions. Moreover, the authors consider how the students pick up on the educational design. The findings show that an educational design involving microblogging can provide new possibilities to facilitate peer interactions by systematically enabling students to access more of their peers' ideas, produce and discuss collective ideas and participate in exploratory talk. In particular, the use of hashtags proves suitable for facilitating peer interactions with the aim to develop students' critical thinking.

Introduction

Recent studies indicate that microblogging has the potential to promote learning. Microblogging used in the classroom enables learners and instructors to instantly exchange ideas with each other (Gao et al., 2012; Ludvigsen et al., 2019; Preston et al., 2015). However, most of these studies report on higher education. Additionally, only a few studies assess the co-located use of microblogging and face-to-face interactions (Tang & Hew, 2017). In this article, we present and discuss the co-located use of microblogging in a classroom activity in which students from a Norwegian lower secondary class explore the distinction between facts and opinions. The activity involves a microblogging tool designed to support interactions through both oral and written communication.

As with other educational technologies, teachers must think about how to embed microblogging in a pedagogical approach for it to be productive for learning (National Academies of Sciences, Engineering and Medicine, 2018). Dialogic pedagogy is beneficial for classroom interaction and learning (Howe et al., 2019), and studies suggest that microblogging might provide valuable support to this pedagogical approach (Major et al., 2018; Rasmussen & Hagen, 2015). We understand dialogic pedagogy as an approach that promotes productive interactions. Broadly conceived, productive interactions can refer to interactions through which students and teachers construct knowledge and understanding, and try new ways of understanding by sharing ideas, challenging and listening to each other, building on each other's ideas, elaborating, providing reasons and thinking together while aiming for specific educational goals (Mercer & Littleton, 2007). However, designing activities

that promote productive interactions can be challenging. Classrooms are dynamic environments that increasingly depend on technology, and classroom activities need to be prepared for the unexpected; thus, both planning and improvisation are important parts of teachers' work (Lund & Hauge, 2011).

Our focus in this article is the educational design of an activity using a microblogging tool called Talkwall. We consider the educational design to include the teacher's planned activities and learning objectives, which are influenced by the wider context of the school and the plans and requirements of local and national curricula. Furthermore, the educational design includes the teacher's enacted design, which takes place during the process of realising and developing learning intentions (deSousa & Rasmussen, 2019; Hauge et al., 2007).

We followed one teacher and her class of 23 lower secondary students at a school located in a large Norwegian city. The teacher and her students participated in a larger research project called Digitalised Dialogues Across the Curriculum (DiDiAC), which focuses on developing new classroom tools and practices, particularly collaboration and critical thinking skills (evaluating and integrating information, forming and justifying ideas, and communicating in and across knowledge domains). The lesson we studied for the purpose of this article addressed the central aims in the national Norwegian language curriculum and the Basic Skills Framework (Utdanningsdirektoratet, 2018). Notably, the focus of the lesson was to distinguish between facts and opinions and to listen to and build on each other's ideas. These skills, especially student oral competencies, are closely connected to the development of critical thinking, which is now one of the overarching goals in the Norwegian core curriculum (Utdanningsdirektoratet, 2020), as recognised in several policy documents (e.g., Organisation for Economic Co-operation and Development, 2018). Despite the need to develop critical thinking skills in education, few scholars have suggested specific ways for teachers to support this development in Norwegian students, especially younger students (Ferguson & Krange, 2020). Our aim is to address this challenge by investigating a lower secondary teacher's lesson design and show how the students picked up on this.

Research questions

- What characterises the teacher's educational design of an activity that uses a microblogging tool?
- How do the students pick up on the teacher's educational design?

The educational use of microblogging in classrooms

Microblogging is the process of posting short messages in a shared digital environment for every participant to see. One well-known example is Twitter. When used as a collaborative virtual learning environment, microblogging has the potential to promote learning for two reasons: first, resources can be shared instantly among learners, and second, instructors can exchange ideas with students in a timely manner (Gao et al., 2012). This section's literature review focuses on (1) the co-located use of microblogging in a classroom context and (2) how to use microblogging to promote oral dialogue. However, studies within higher education dominate the scholarly literature; thus, we include findings that may translate into a primary school context.

In one study, students in a Bachelor's course used Twitter to share their reflections about personal learning and their ideas relating to the course materials (Preston et al., 2015). The students found that this reflection assignment helped them engage with the course material. In addition, viewing their peers' reflections raised the students' awareness of perspectives or content that they had missed. Also, Mercier et al. (2015) found that instructors and students who were using Twitter in an undergraduate course gained insight into group discussion activities during class, thus ensuring that ideas emerging within group could enter whole-class conversations. This study found that using Twitter within classroom activities increased the amount of on-task talk, allowed instructors to

redirect discussions during activities and provided the possibility of using the shared representation of tweets to direct the final conversation of the whole class, which allowed for more focused discussions. In another study where the online whiteboard Flinga.fi was used in a university lecture, students shared ideas and opinions through written posts and then subsequently justified, elaborated on and explained these perspectives (Ludvigsen et al., 2019). This study identified the potential to increase interactions among students and between students and lecturers, encourage creative knowledge processes through dialogue and create new, rich opportunities to reflect on concepts and developing arguments. An additional study showed that using a response system in combination with peer discussions engaged students, and the teacher could follow up on their answers, asking them to provide further reasons or explanations (Egelandsdal & Krumsvik, 2019). The teacher created tension between the students' ideas and those of the discipline by engaging with the students' answers (i.e. discussing different perspectives, relating ideas to one another or comparing and contrasting ideas). This can create opportunities for students to draw connections between their everyday views and those of the course, and to become more aware of different perspectives regarding a topic (Egelandsdal & Krumsvik, 2019). Meanwhile, using a microblogging tool called Socius, secondary high students from another study wrote short summaries that were displayed on a shared screen in the classroom (Rasmussen & Hagen, 2015). The study showed that this microblogging technology made students' thinking visible to other participants and opened up new possibilities for engaging in classroom dialogues. Furthermore, it increased participation and seemed to bring the students' and teachers' different understandings of the topic closer together, as the teacher elaborated on whole-class discussions emerging from the students' own work. More recent studies have also found the use of microblogging to mediate the uptake of student contributions (Omland & Rødnes, 2020) and to be productive in mediating and connecting learning activities, such as peer talks and whole-class conversations (Frøytlog & Rasmussen, 2020; Omland, 2021).

Finally, we consider technology beyond microblogging that can be used in a co-located manner to promote oral dialogue in classrooms. By using the Promising Ideas Tool, a Knowledge Forum (Scardamalia & Bereiter, 2006) extension, Grade 3 students selected promising ideas from their group's written online discourse, then aggregated and displayed their selections to support collective decision making regarding the most promising directions for subsequent work (Chen et al., 2015). The selected ideas would become the focus of class discussions and subsequent knowledge-building efforts. The study showed that elementary students achieved significantly greater knowledge advances than students who were not engaged in the identifying and judgement of promising ideas and discussions. In a final study, Grade 4 students used Knowledge Forum for three successive school years (Zhang et al., 2009). The researchers then analysed the students' awareness of peer contributions as the students built their complementary contributions by referencing the ideas of others. Their distributed engagement emerged and extended the fixed student groups, supported by Knowledge Forum, connecting them to a broader network of students and ideas. This study ultimately suggested that a flexible and opportunistic collaboration framework can produce high-level collective cognitive responsibility and dynamic knowledge advancement.

Another type of technology that combines written and oral dialogue to promote productive interactions among students is the interactive whiteboard (IWB). An exploratory paper considered the IWB a dialogic space used for reflection, which may create opportunities for learners in primary schools to generate, modify and evaluate new ideas through multimodal interaction, along with talk (Hennessy, 2011). The author pointed to visible, dynamic and constantly evolving digitally represented knowledge artefacts (e.g., text, images or figures) on the IWB that constitute temporary records of activity. These are functioning as supportive resources for students' emerging thoughts and ideas, rather than the finished products of the students' discussions. In another study, students in primary classrooms collaborated in a variety of science activities using an IWB, and they could engage effectively in the collective learning experience, called the shared dynamic dialogic space (Kershner et al., 2010). The study suggested that the conditions for success, which need to be established in the classroom, include the children's joint

understanding of the task, their positive motivation and responsibility for learning, and their active support for each other. In Talk Factory, a software designed to model and represent exploratory talk on an IWB, teachers could evaluate and monitor the students' talk in relations to the class talk rules. This tool changed the nature of students' dialogue and resulted in more exploratory talk (Kerawalla et al., 2013).

What emerges from these studies, first and foremost, is that microblogging technology can extend the possibilities for students to participate in both whole-class and group interactions. Furthermore, the possibility of combining short written messages with oral discussions can make students' ideas visible, enabling them to travel more easily between whole-class and group conversations. As most microblogging studies have been conducted within higher education, less is known about how microblogging can be adopted in classrooms with younger students. As far as we know, there are no contemporary studies that investigate how teachers' educational design of a particular microblogging activity intended to develop students' critical thinking can support students as they engage in productive interactions. More focus on the value of the practices and practical procedures linking productive interactions and microblogging technology is necessary to encourage primary and lower secondary school teachers to adopt such practices (Mercer et al., 2019). Thus, we advance the research by investigating how one teacher embedded microblogging into her educational design to promote productive interactions within the larger context of developing her students' critical thinking.

Educational design for productive interactions

When embedding microblogging in an educational design, it is crucial to use a clear pedagogical approach, with dialogic pedagogy proving especially valuable in this respect (Major et al., 2018). Dialogic pedagogy focuses on the ongoing process of interactive and recursive meaning making among participants, promoting talk as a powerful tool to foster students' thinking, learning and problem-solving skills (Alexander, 2004; Wegerif et al., 2019). One specific kind of talk considered to have great educational value is exploratory talk (Barnes & Todd, 1977). This is talk in which all members are invited to contribute, and all relevant information is shared. Moreover, everyone's ideas are respected and considered, and everyone is asked to make their reasons clear. In this type of talk, challenges and alternatives are made explicit and negotiated, and before making a decision, the participants seek to reach agreement. Implicit in exploratory talk is the development of critical thinking, which occurs because it makes thinking visible and offers exposure to different perspectives. Through exploratory talk, students can become involved in each other's thinking as they develop their own (Littleton & Mercer, 2013).

To use language to generate productive interactions, students need explicit guidance and training. One strategy that ensures students are aware of appropriate ways to interact is developing 'talk rules' with them that highlight the principles of participating, reasoning, challenging ideas and collaboratively making decisions (Gillies, 2016; Mercer et al., 2004). The development of, and explicit focus on, talk rules promote both students' and teachers' awareness of what have been termed dialogic intentions in the lesson (Warwick et al., 2020). In addition to explicitly being taught, students benefit from practising these talk features through social interactions (Littleton & Mercer, 2013). Consequently, the activity itself needs to be carefully considered if the intent is to promote productive interactions; thus, one key point is to design an activity that includes a reason to talk together. Therefore, the design of the activity should require all students to contribute and share information, respect each other's ideas, ensure the students have a shared understanding of the purpose of the activity and are aware of how to use talk appropriately (e.g., by explicitly focusing on talk rules). Hence, when embedding microblogging technology in dialogic pedagogy, teachers must determine how the tool can serve the educational goals and how to enact the relevant functions within the tool. We investigate this further in our article by focusing on how a teacher's educational design was realised through and with technology when students explored the distinction between facts and opinions using a microblogging tool.

Method

Context of the study

The school involved is in the centre of a large Norwegian city, and the class consisted of 23 students (aged 12–13). The class participated in the design-based research project DiDiAC, focusing on how teachers can integrate the microblogging tool Talkwall into their practices to support student participation in productive interactions. The teacher was unfamiliar with microblogging for educational activities prior to this project, but she had previous experience with other digital tools. The students in the class had individual iPads and were familiar with using them both in the classroom and at home. The DiDiAC project included four introductory teacher–researcher workshops and collaborative planning meetings, during which teachers and researchers discussed how Talkwall could be embedded in learning activities. These discussions occurred prior to three observed lessons; after these lessons, the teachers and researchers discussed their experiences. During these meetings, the teachers and researchers also collaboratively explored the elements of the 'Thinking Together' approach (Mercer et al., 1999), such as developing talk rules and embedding Talkwall in an educational design to promote productive interactions. Thus, the teacher examined in this article was in the process of developing her thinking about dialogic pedagogy.

Talkwall (Figure 1) is designed to support co-located interactions through both oral and written communication, and it is specifically based on a research-based understanding of dialogic pedagogy as it is established in the Thinking Together approach (Mercer et al., 1999). Talkwall was developed through a 10-year co-design process, in which its design was adapted according to teacher experiences and feedback. In this article, we consider 'bridging concepts' (further elaborated in Smørdal et al., 2021) to inhabit a 'middle ground' between educational theory and teachers' educational design. The following bridging concepts (listed below in italics) can help unveil and articulate untried design opportunities and connect theoretical concepts and dialogic pedagogy with the affordances of Talkwall
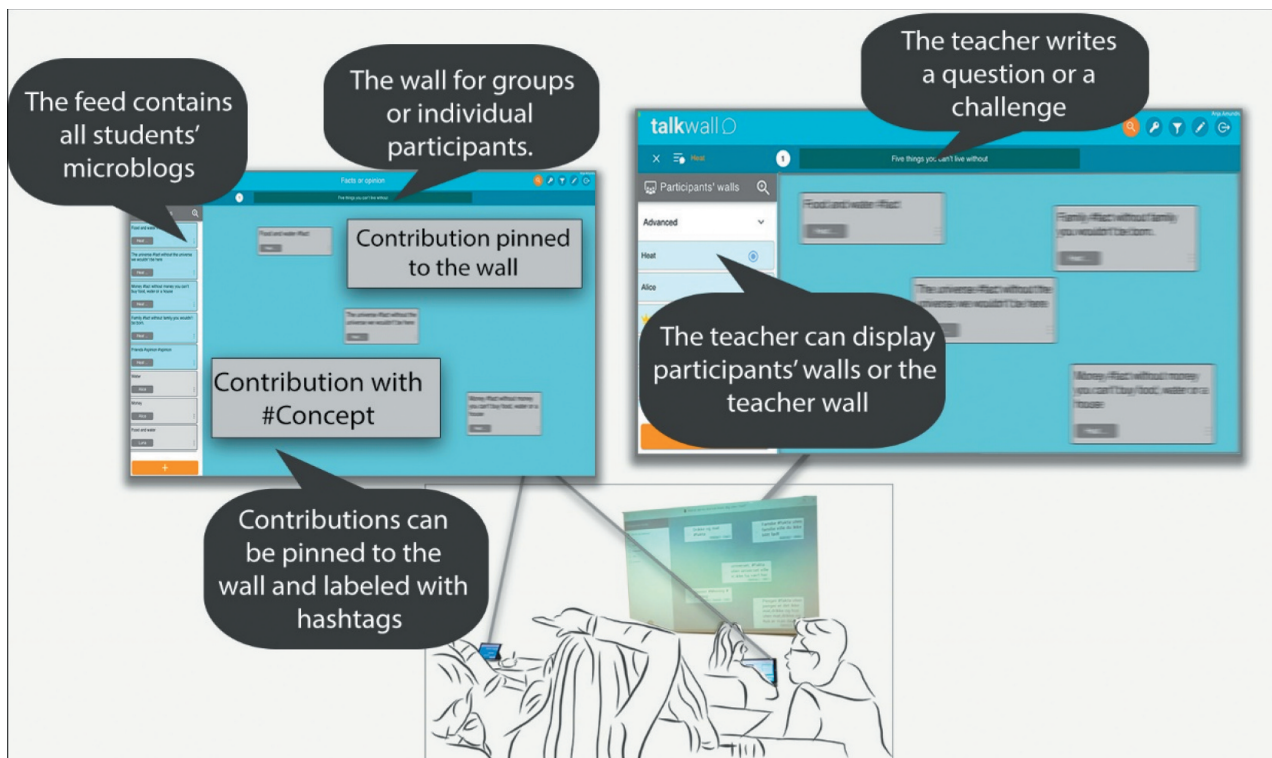

Figure 1. Talkwall representation of the student wall to the left and the teacher wall to the right. The figure shows contributions, or microblogs, that are selected from the feed and pinned to the wall.

- *A contribution* is a microblog or digital representation of an idea, presented as a short message with limited characters (140–500) that enhances, rather than replaces, oral dialogue.
- *The feed* of microblogs provides a mutual awareness of all ideas contributed to Talkwall. The feed is shared on all participants' devices and offers a means for students to share their contributions with their peers.
- *The wall* allows microblogs to be promoted from within the feed and represents them on a spatially organised surface.
- *The space for the teacher* provides access to all participants' walls and enables the teacher to display any wall to the class.
- *Hashtags (#)* can be added by the participants to contributions, for example, to follow select topics or organise different points of view. Both the teacher and students can filter the microblogs with the hashtags.

During a lesson, a main Talkwall window is displayed at the front of the class on a projector or large screen and is usually controlled by the teacher. The students have their own individual or group walls that are accessible and controllable using any device with a web browser.

Data collection and analytical work

The lesson analysed for the purpose of this article was selected from the DiDiAC project dataset for two main reasons. First, the teacher embedded several functionalities in Talkwall in her educational design, such as the deliberate hashtagging of all contributions, which we did not see in any other lessons in our dataset. Second, Talkwall was used for two purposes: homework and lessons. During the entire lesson, Talkwall was also used for both whole-class and group interactions.

We consider the video-recorded classroom interactions (67 minutes of the whole class and 65 minutes focusing on one group) and the Talkwall blogs as our primary data. Field notes, one audio-recorded teacher–researcher meeting (40 minutes) and the teacher's plan for the lesson supplemented and contextualised the primary data.

Studies addressing the sequential nature of the learning process (Rasmussen, 2012) emphasise learners' interactions across situations. To show the role of technology in the classroom and investigate both how interactions are stimulated and what precedes them, there is a need to provide a narrative of the whole lesson (Kershner et al., 2020). Thus, our analysis involves two levels: the trajectory level and the interactional level. The levels of our analysis inform each other to provide insights on how knowledge and activities become relevant at specific times and stay relevant throughout an activity (deSousa & Rasmussen, 2019).

At the trajectory level, we characterised the teacher's design of the learning activity and structured the lesson into sequences. Inspired by thematic analysis, we identified patterns within the data (Braun & Clarke, 2006). During the process of repeatedly viewing the video-recorded lesson, we described and categorised how the lesson unfolded over time. Here, we identified how the teacher planned and enacted the activities, including how she embedded Talkwall in the educational design.

We examined the teachers' and students' oral interactions and their interactions with Talkwall to determine how the teacher's educational design fostered student engagement in productive interactions. The video recordings from the classroom were transcribed verbatim in Norwegian and translated into English for the present article. The Talkwall blogs were integrated into the transcript as well to determine the role of the written contributions in relation to the face-to-face interactions. More specifically, we analysed tabularised transcripts of video recordings, in which a select number of automatically logged Talkwall interactions were integrated based on their timestamps. The Talkwall interactions we considered were 'create contribution', 'edit contribution', 'promote contribution' and 'teacher display group wall'. Together, the video recordings and the Talkwall log allowed us to investigate the dialogic characteristics of productive interactions and the role of Talkwall in these interactions.

The excerpts in the Results section were selected for their relation to the research questions. In particular, the excerpts illustrate the educational design of the Talkwall activity, describing how it was used to promote productive interactions and how it was picked up on by the students. The excerpts presented in the Results section include contributions in Talkwall, represented as simplified versions of how they appear on the students' screens. In the article, the students and the teacher are anonymised, and we have followed appropriate research ethics and privacy guidelines (Norwegian Data Protection Services, n.d.).

Limitations

This is a qualitative study intended to explore how to embed a microblogging tool in a lesson to engage students in productive interactions. However, by identifying some important aspects of the teachers' educational design, we offer insight into the students' interactions in situations that may support their development of dialogic skills, which in turn can support the development of their critical thinking.

Results

The teacher's educational design

We begin by describing and analysing at the trajectory level what characterised the teacher's educational design of the Talkwall activities. We have divided the activities into five main parts, as described in Figure 2.

Part one consisted of the teacher–researcher meeting. Talkwall was used during the meeting for demonstrations, and the Talkwall functionalities were discussed in relation to the planned subject-specific activity.

Part two started with a homework assignment in which the students contributed to Talkwall five things that they cannot live without. When the lesson began, the teacher introduced the lesson plan and the dialogic intention (Figure 3). She reminded the students about the class talk rules (Appendix A1) and explicitly stated how the students could use the class talk rules in their discussions. The students were also provided with the sentence openers 'Why did you choose that?' and 'Can you say more about that?'

In part three, the teacher and students explored some differences between facts and opinions. Then the students were instructed to label all the Talkwall blogs in the feed as either #opinion or #fact. During this group activity, the teacher explicitly pointed out that the students must give
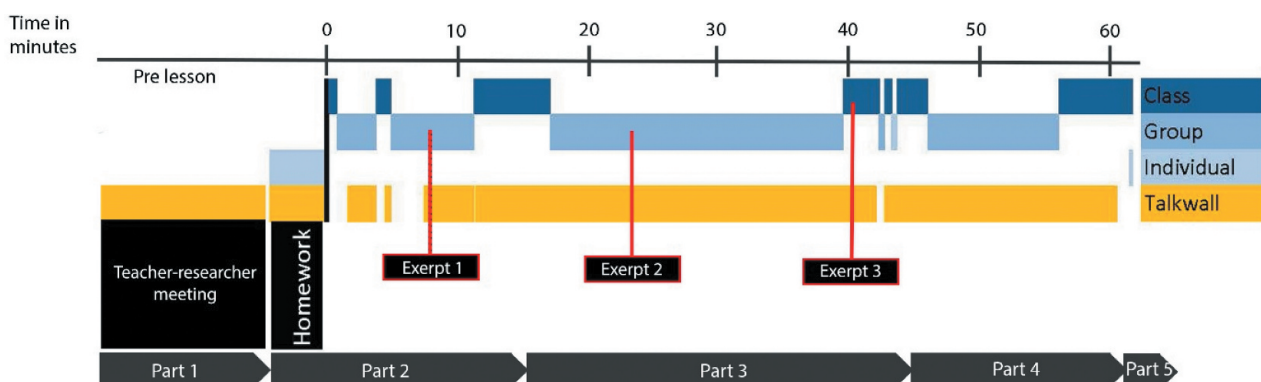

Figure 2. Representation of the educational design at the trajectory level. The teacher–researcher meeting was an unstructured planning meeting lasting approximately 40 minutes, and occurred a few days before the lesson. The lesson was 67 minutes long and alternated between group and whole-class activities, with a short individual activity at the end and an individual homework activity. Talkwall was actively used during most of the lesson.

Norwegian March 23

1. What is it that you cannot live without?
2. Distinguish between facts and opinions.
3. Make a new list with your group.
4. Is your list the same?

We ask everyone for his or her opinion before we make a decision

Figure 3. Lesson plan with four main activities and the dialogic intention in the speech bubble (authors' translation).

reasons for their hashtags, and they must reach agreement as a group on their choice. They were also provided with a sentence opener that was visually displayed on the whiteboard: 'Why is this a fact/ opinion?' The group activity was followed by a whole-class discussion using Talkwall.

In part four, the teacher introduced the activity, which was to make a new list of five things that each student cannot live without. The students had to reach an agreement within the group before promoting the new list of contributions to the group wall. Next, the students and the teacher discussed the new lists as a whole class using Talkwall. The last part was an individual reflective activity, ending with the students writing a new list and reflecting on whether they changed their minds.

To summarise, the learning activities involved both group and whole-class interactions using Talkwall. The teacher's dialogic intention for the lesson was for all students to be asked their opinions and provide reasons for their answers. The Talkwall activities were designed to accomplish this intention.

The students' uptake of the educational design

The students and the teacher used Talkwall throughout the lesson, which was highly interactive (as illustrated in Figure 2). The students individually contributed to Talkwall through their homework, and groups of students contributed during the lesson. They used several Talkwall functions; contributions were created, promoted, edited and moved from the feed to the wall, where they were spatially organised. Throughout the lesson, the teacher used the teacher space in Talkwall to select six of the nine group walls for display on the large wall to support whole-class discussions. Moreover, all microblogs were extended during the lesson with a hashtag.

The hashtagging activity in Talkwall required the students to read and discuss several of their peers' contributions to decide whether to use the #fact and/or #opinion hashtags. We have selected three excerpts from different parts of the lesson to analyse this aspect of the students' uptake of the educational design. The excerpts are translated from Norwegian by the authors and presented with standard punctuation. Double parentheses contain the analyst's comments or descriptions and (.) indicates brief intervals or pauses between the end of a word and the beginning of the next.

Excerpt 1: 'Why did you select money?'

This excerpt is from part two of the trajectory presented in Figure 2. We focus on one group with two students, Alice and Leo. In the excerpt, Alice presents to Leo the five things that she has decided that she 'cannot live without'. The iPad displays their group Talkwall, with Alice's contributions in the feed.

Turn	Speaker	Dialogue
1	Alice	((Scrolling the Talkwall feed and reading her own microblogs)) Food, water, money, friends, family.
2	Leo	Okay (.).
3	Alice	((Turning towards the teacher, who is passing by while making the rounds and standing next to the group)) What should we do now?
4	Teacher	((Scrolling the Talkwall feed and reading Alice's contribution 'Friends')) So, why did you choose friends?
5	Alice	((Addressing the teacher)) Because . . .
6	Teacher	((Walks away, indicating with her hands that the students should turn and talk to each other))
7	Alice	((Turning to Leo)) . . . my friends are cool, so they make me cool. ((both laughing))
8	Alice	Um, no, because my friends are the ones who make me happy.
9	Leo	((Reading from the feed in Talkwall)) Why, um, why did you choose money?
10	Alice	Money because, ((looking at Talkwall)) you see someone has said 'Clothes' and things like that ((pointing to a Talkwall contribution)), but without money you cannot buy clothes.

Alice starts by listing her five things. Leo answers 'okay'. The short pause and the fact that Alice turns to ask the teacher what they should do next indicate that this is the end of their conversation. The teacher then uses Talkwall to access Alice's microblogs by scrolling the feed. She finds one of Alice's microblogs – 'Friends' – and encourages the two students to provide reasons by saying, 'So, why did you choose friends?', referring to the sentence openers introduced earlier in the lesson. Alice picks this up, and in the remainder of the transcript we see that, not only does she give reasons for her arguments (turns 7 and 8), but Leo also follows up by requesting reasons (turn 9). Note that Leo uses the Talkwall feed in the same way as the teacher (in turn 4) by asking why Alice chose 'money'. Alice answers by referring to another student's contribution in the Talkwall feed – 'Clothes' – to support her argument, saying 'without money you cannot buy clothes'.

This brief excerpt shows some important functions of microblogging. First, we see that the teacher can easily access the students' contributions through Talkwall as she makes her rounds to support group work in the classroom. Second, when the students' peer-group talk fades out (turns 2–3 and 9), access to Talkwall blogs in the feed seems to play an important role in prompting the students to talk and stay on task. Third, access to other students' contributions in the feed brings new perspectives to the conversation and ensures that ideas are shared with the whole class. Important to note is that the students (supported by the talk rules, sentence openers and Talkwall) also challenge each other (turn 9) and attempt to make their reasons clear (turn 10), which are important features of exploratory talk.

Excerpt 2: #Fact or #opinion

We now turn to part three of the lesson, in which the activity requires the students to hashtag as many contributions as they can within the time provided. Alice and Leo need to agree on the hashtag before hashtagging the contributions. They read other students' microblogs in the feed, starting from the top and scrolling through the first few. The iPad displaying Talkwall is placed between them, and both look at the contributions in the feed while Alice scrolls.

| Turn	Speaker	Dialogue
1	Alice	((Reading from the Talkwall feed)) Fact. ((Pointing to 'Water')) Fact. ((Pointing to 'Food'))
2	Leo	((Nodding))
3	Alice	'My memory'. ((Pointing)) What do you think?
4	Leo	((Looking at Talkwall)) No.
5	Alice	((Turning towards Leo)) No? So, people don't remember who their friends are?
6	Leo	I do not care.
7	Alice	They do not remember to eat, to drink water for example, . . .
8	Leo	((Laughs))
9	Alice	. . . they do not remember, they don't remember anything. Their names, who their family is, who . . . .
10	Leo	I can just select another family then.
11	Alice	But, what if you forget what a family is?
12	Leo	Oh (.).
13	Alice	((Turning towards Leo)) Yes, you see it is a fact (.).
14	Alice	So, 'My memory'. ((Pinning the contribution to their group wall)) What should we do now?
15	Leo	Oh, write fact.
16	Alice	((Hashtagging the contribution, as seen in Figure 4, which represents the student view of Talkwall while editing and hashtagging))
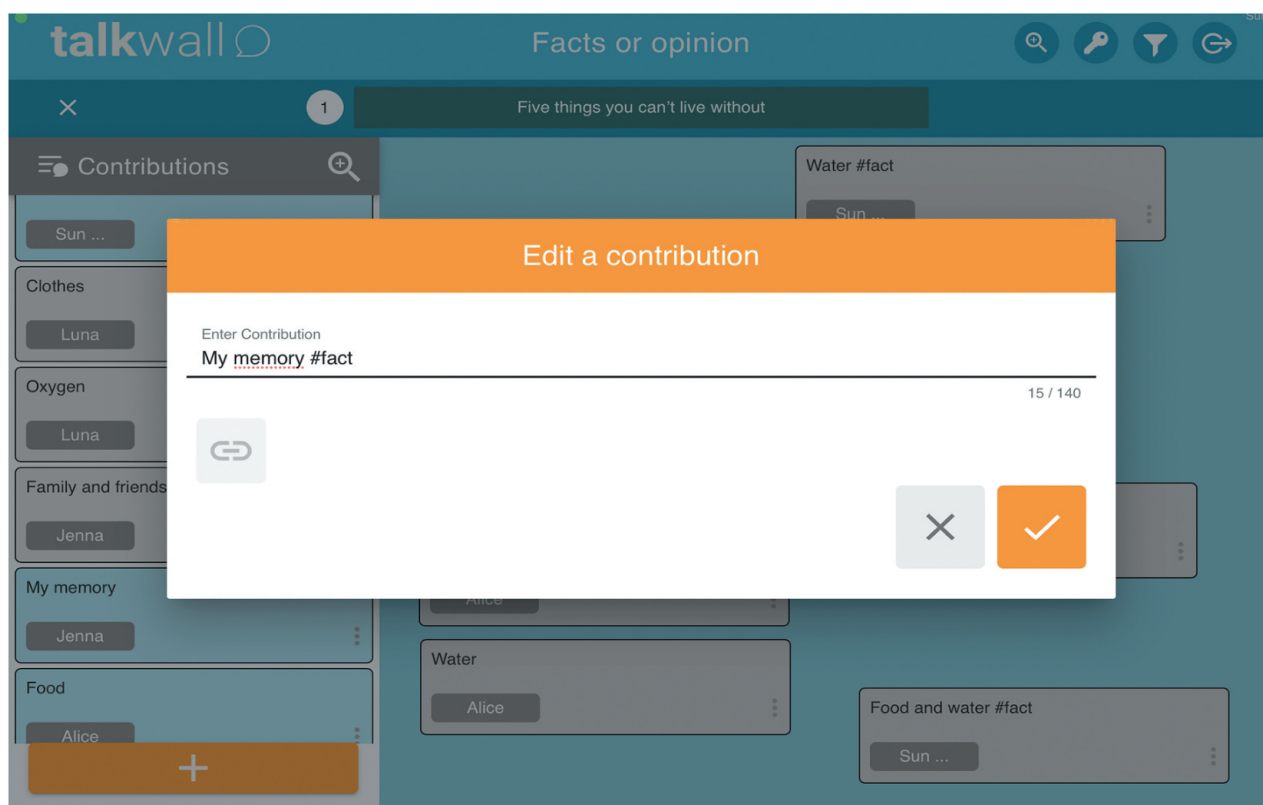
Figure 4. What Talkwall looks like when students edit or hashtag other students' microblogs.

Alice scrolls the feed and comments on what she is reading. She points to 'Water' and 'Food' and states that these are 'facts'. Leo nods. Without hashtagging these, she continues to scroll before she stops at the contribution 'My memory'. The next exchange suggests that Leo does not think 'My memory' should be classified as a fact (turns 3 and 4). Alice, in what appears to be a surprised tone, turns to Leo and asks 'No?' Her invitation does not follow the conversation openers as in excerpt 1; rather, her question appears authentic. In what follows, Alice argues why you cannot live without

your memory, while Leo, in what seems to be a humorous tone or an attempt to save face, challenges and argues against her. In turn 12, after a few moments of silence, Leo says 'oh'. In turn 14, we see that Alice invites Leo to conclude that they should label the contribution with #fact.

This excerpt demonstrates that the feed, which includes all groups' contributions, exposes the students to more alternatives and different perspectives. We see that when 'My memory' arises in the feed, which was a contribution made by another student, Alice and Leo discuss both fact and opinion before reaching an agreement. The design of the activity is central to how the students interact, both within the group and in the whole class. The interaction with other students' ideas is embedded in the design of the hashtag activity, which encourages the students in the group to engage with all other students' contributions. Additionally, the design of the activity encourages the students to agree on a joint decision; to support this goal, the teacher instructed the students to give reasons for their answers (part 3). The hashtag activity in Talkwall also distributes the students' ideas/judgements about whether the contribution is a fact or opinion to the rest of the class. Importantly, this activity prompts students to distinguish between facts and opinions. In this case, we see that the distinction is not clear-cut for these young students. Making distinctions and providing reasons are important to critical thinking. A simple task, such as the one we exemplify, might prove an entry point for making more advanced distinctions and backing them up with reasons later.

Excerpt 3: 'Did you all agree?'

This excerpt is from part three of the lesson. The whole class turns their attention to the whiteboard in front of the classroom. The teacher, standing before them, presents the participants' walls. As we examine excerpt 3, we see that she selects and displays one group wall (Figure 5) to the whole class.

Turn	Speaker	Dialogue
1	Teacher	Here you are. ((Looking at group Talkwall)) Family, you discussed this a bit, didn't you? Ron, what can you say about that?
2	Ron	The point is that without a family you would not have been born.
3	Alex	((interrupting)) Yes, but . . .
4	Teacher	((To Alex)) No, I know this is engaging, but you have to wait for your turn. Did you have anything to add to this in your group? You had something to add. Did you all agree?
5	Sarah	No.
6	Teacher	Okay, what did you say?
7	Sarah	We said that . . . .
8	Liam	((interrupting Sarah)) There are a lot of people who survive without a family.
9	Sarah	Family are just people who stand by your side a bit more than other people.
10	Teacher	Yeah. Are there others who want to elaborate or say more about this? (.) Alex?
11	Alex	I don't think it is a fact. I think it is more opinion, because family, you do not need to have a family to live. I was thinking about people who don't have a family. They survive, right, in orphan homes. Therefore, it is an opinion, I think.

The excerpt starts with the teacher asking Ron to share with the class the discussion he had with his group. Alex, from another group, eagerly interrupts, but is stopped. Ron gives the reason for why he and his group labelled family as 'fact', saying, 'Without a family you would not have been born.' The teacher presses on, asking if the group managed to reach an agreement. Building on each other's utterances in turns 7, 8 and 9, Sarah and Liam argue that family should have been hashtagged as 'opinion'. In turn 11, the teacher selects Alex to elaborate further on why he thinks family 'is an opinion'.

The excerpt demonstrates how contributions from one group are picked up and function as visual support for whole-class discussions. The teacher space in Talkwall provides the teacher access to the participants' walls. This enables the teacher to distribute the results from the group discussions and initiate a whole-class discussion based on the group talk, aided by visual support from Talkwall. In addition, we see that she presses on and directly asks about the groups' previous discussion. We also

Figure 5. A representation of the group wall, particularly the group 'Heat'. On their wall, they have pinned and hashtagged five microblogs.

see that Alex, who was not part of this group, eagerly elaborates on his stance. The visual support enables focused discussion, providing the students a shared or collective space for class dialogue (Wegerif et al., 2019).

The design of this activity ensured that all the students participated in and contributed to the group during the whole-class discussions. As such, the students' thinking was shared and travelled via the 'feed', the Talkwall contributions and the oral dialogue. By displaying the groups' walls with microblogs and hashtags to the whole class, the students' participation in the group extended into the whole-class discussion, despite the fact that they did not directly contribute to the whole-class discussion. This means that even those who did not participate orally did so through the written contributions that they produced during group discussions or homework assignments.

Further, the group discussions became more permanent, as the students used Talkwall to document their work. Doing so seemed to make the group discussions more targeted and focused, as we demonstrated in the first example, because the students had access to a pool of their peers' ideas. Moreover, Talkwall seems to support the teacher in using strategies that promote exploratory talk (Mercer & Littleton, 2007).

As we have seen, Talkwall and what we consider bridging concepts made possible an educational design that enabled (1) all students to contribute and share their ideas and (2) all students' opinions and ideas to be considered, exposing the students to different perspectives. Moreover, the educational design, infused with dialogic pedagogy, promoted exploratory talk and enabled students to challenge each other, ask everyone to clarify their reasons and reach agreements as a group. These are important aspects in the development of critical thinking.

Discussion

We now relate the analysis of the teacher's educational design and the students' uptake of this design to the key themes that emerged from our analysis.

Permanence – the written and oral co-constitute

We observed that the educational design, in particular the #fact and #opinion labelling activity, encouraged the students to interact and think critically about their peers' ideas. Embedding Talkwall in this activity visualised the ideas of others over time, representing these ideas in the feed and enabling them to be edited. We believe that the permanence of the contributions and the fact that the contributions are tangible and available for selection and organisation on the wall made them available to other students to build upon. The permanence of the contributions enabled the students to have more focused discussions as well (Mercier et al., 2015). Previous studies report similar results for students engaged in the identifying and judgement of their peers' ideas and referencing the ideas of others using Knowledge Forum (Chen et al., 2015; Zhang et al., 2009). In the educational design, the distinction between facts and opinions was not clear-cut and relied on everyday concepts. Hence, the students were given the opportunity to practise the elements of exploratory talk in an authentic context (Mercer et al., 2019). Other studies regard this type of educational design as useful when teachers wish to undertake dialogic pedagogy and enhance interactions productive to learning (Mercer et al., 1999).

Try out ideas safely

The educational design in this study encouraged students to discuss and agree as a group before deciding on the wording of the contribution that would be shared in the whole-class discussion. This design was also accompanied by the 'talk rules' about joint decision making (Mercer et al., 2019) that were co-developed in the class and explicitly referenced by the teacher. We also observed that the teacher's educational design gave students time to try out their ideas in small groups before sharing their written ideas, which can make participation in whole-class interactions more available to all students.

Concurrency – multiple participation options

Writing a contribution in Talkwall can be done concurrently; hence, students can contribute their answers without being interrupted or while waiting for their turn, which gives them time to reply with thoughtful responses. This can contribute to more equal participation than is attainable through face-to-face, whole-class discussions alone (Frøytlog & Rasmussen, 2020; Omland, 2021).

Teacher awareness

Embedding Talkwall in the activity allowed the teacher to direct the whole-class discussions in a way that enhanced elaboration, built on the groups' discussions and mediated the uptake of student contributions (Mercier et al., 2015; Omland & Rødnes, 2020). For example, when the students' contributions were displayed on the wall, there was often a need for more thorough explanations because of the short format. A typical strategy for this teacher, when considering the students' contributions on the group walls, was to ask follow-up questions such as 'Can you say more about that?' or 'Did you all agree on this?' These questions seemed very natural to ask in the context of the whole-class discussions involving Talkwall. This indicates that using microblogging within the context of dialogic pedagogy and in combination with face-to-face communication can support teachers' work in facilitating student efforts when they practise taking part in exploratory talk (Mercer et al., 2019).

Wall talking

Talkwall is a microblogging tool that also has IWB properties, such as being a 'shared dynamic dialogic space' (Kershner et al., 2010) and a focal point for learners' emerging thinking (Hennessy, 2011). The educational design made use of the two representational means in Talkwall, the feed and the wall, to assist the students' talk and their collective understanding, to provide access to other ideas that extend the discussions beyond the groups, and to support the students as they deepened the discussion by challenging ideas presented in the feed. The teacher used these representational means by displaying either the teacher wall or one of the group walls on the classroom's large screen to focus the entire class's attention. We observed that sharing written contributions between groups widened the dialogic space by providing access to more ideas and different perspectives. Moreover, as the lesson design encouraged the students to select other ideas and label them with hashtags, the dialogic space deepened as they questioned and challenged the ideas of other groups (Cook et al., 2019; Warwick et al., 2020).

Conclusion

The findings from this study show that educational design involving microblogging can provide new possibilities for peer interactions by systematically enabling students to (1) access more of their peers' ideas; (2) produce and discuss collective ideas; and 3) contribute to and participate in exploratory talk. In particular, the creative use of hashtags proved a suitable mechanism for facilitating peer interactions that promote critical thinking. The contributions, the feed, the wall, the space for the teacher and the hashtags, all termed bridging concepts (Smørdal et al., 2021), were key elements of the educational design, intended to enable the students to explore the distinction between facts and opinions, and to promote exploratory talk. Educational research has shown that engagement in dialogue can stimulate contrasting ideas, support students in focusing on the most relevant issues in information sources and provide them examples of the skills that underlie critical thinking (e.g., Ferguson & Bubikova-Moan, 2019). Our research, which empirically investigated the teacher's educational design and the students' uptake – in which participants are encouraged to engage critically yet constructively with each other's ideas – suggests that peer-group interactions can be developed to improve students' critical thinking. Designing educational activities to use digital technology can engage young students in activities that are known to foster critical thinking skills. We argue for dialogic pedagogy as a way of increasing learning opportunities (e.g., Howe & Abedin, 2013). As our study demonstrates, the students practised several skills that are known to be educationally productive for learning, including asking questions, giving reasons, providing evidence and elaborating on others' ideas in activities enabled by digital technology.

Acknowledgments

Disclosure statement

Funding

Notes on contributors

Anja Amundrud is a doctoral research fellow at the Department of Education, University of Oslo. She has a background as a primary school teacher, and her PhD research focus is on teaching and learning with new technologies. Amundrud is also interested in the design and development of digital resources.

Ole Smørdal is a researcher at the Department of Education, University of Oslo. His background is in computer science. He has long experience in the intersection between design, education and computer science. He has specialised in research that is based on practice partnerships and adopts design-based and participatory methods in such collaborations.

Ingvill Rasmussen is Professor at the Department of Education, University of Oslo. Her background is educational psychology, and her research focus is on talk and collaboration and how digital technologies transform learning practices. Rasmussen designs digital tools in collaboration with teachers and technology developers to support learning in formal schooling.

ORCID

Anja Amundrud http://orcid.org/0000-0001-7172-6069
Ole Smørdal http://orcid.org/0000-0002-1197-0980
Ingvill Rasmussen http://orcid.org/0000-0001-9688-5912

Ethical approval statement

References

Alexander, R. J. (2004). *Dialogic Teaching* (York: Dialogos).

Barnes, D., & Todd, F. (1977). *Communication and learning in small groups*. Routledge & Kegan Paul.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Chen, B., Scardamalia, M., & Bereiter, C. (2015). Advancing knowledge-building discourse through judgments of promising ideas. *International Journal of Computer-Supported Collaborative Learning*, *10*(4), 345–366. https://doi.org/10.1007/s11412-015-9225-z

Cook, V., Warwick, P., Vrikki, M., Major, L., & Wegerif, R. (2019). Developing material-dialogic space in geography learning and teaching: Combining a dialogic pedagogy with the use of a microblogging tool. *Thinking Skills and Creativity*, *31*, 217–231. https://doi.org/10.1016/j.tsc.2018.12.005

deSousa, F., & Rasmussen, I. (2019). Productive disciplinary engagement and videogames. *Nordic Journal of Digital Literacy*, *14*(3–4), 99–116. https://doi.org/10.18261/.1891-943x-2019-03-04-02

Egelandsdal, K., & Krumsvik, R. J. (2019). Clicker interventions at university lectures and the feedback gap. *Nordic Journal of Digital Literacy*, *14*(1–2), 70–87. https://doi.org/10.18261/.1891-943x-2019-01-02-06

Ferguson, L. E., & Bubikova-Moan, J. (2019). Argumentation as a pathway to critical thinking. In B. Garssen, D. Godden, G. R. Mitchell, & J. H. M. Wagemans (Eds.), *Proceedings of the Ninth Conference of the International Society for the Study of Argumentation* (pp. 352–362). Sic Sat.

Ferguson, L. E., & Krange, I. (2020). Hvordan fremme kritisk tenkning i grunnskolen? [How to promote critical thinking in primary school?]. *Norsk Pedagogisk Tidsskrift*, *104*(2), 194–205. https://doi.org/10.18261/.1504-2987-2020-02-09

Frøytlog, J. I. J., & Rasmussen, I. (2020). The distribution and productivity of whole-class dialogues: Exploring the potential of microblogging. *International Journal of Educational Research*, *99*, 101501. https://doi.org/10.1016/j.ijer.2019.101501

Gao, F., Luo, T., & Zhang, K. (2012). Tweeting for learning: A critical analysis of research on microblogging in education published in 2008–2011. *British Journal of Educational Technology*, *43*(5), 783–801. https://doi.org/10.1111/j.1467-8535.2012.01357.x

Gillies, R. M. (2016). Cooperative learning: Review of research and practice. *Australian Journal of Teacher Education*, *41*(3), 3. https://doi.org/10.14221/ajte.2016v41n3.3

Hauge, T. E., Lund, A., & Vestøl, J. M. (2007). *Undervisning i endring: IKT, aktivitet, design* [Teaching in transformation: ICT, activity, design]. Abstrakt forlag.

Hennessy, S. (2011). The role of digital artefacts on the interactive whiteboard in supporting classroom dialogue. *Journal of Computer Assisted Learning*, *27*(6), 463–489. https://doi.org/10.1111/j.1365-2729.2011.00416.x

Howe, C., & Abedin, M. (2013). Classroom dialogue: A systematic review across four decades of research. *Cambridge Journal of Education*, *43*(3), 325–356. https://doi.org/10.1080/0305764X.2013.786024

Howe, C., Hennessy, S., Mercer, N., Vrikki, M., & Wheatley, L. (2019). Teacher–student dialogue during classroom teaching: Does it really impact on student outcomes? *Journal of the Learning Sciences*, *28*(4–5), 462–512. https://doi.org/10.1080/10508406.2019.1573730

Kerawalla, L., Petrou, M., & Scanlon, E. (2013). Talk factory: Supporting "exploratory talk" around an interactive white-board in primary school science plenaries. *Technology, Pedagogy and Education*, *22*(1), 89–102. http://doi.org/10.1080/1475939X.2012.745049

Kershner, R., Hennessy, S., Wegerif, R., & Ahmed, A. (2020). *Research methods for educational dialogue*. Bloomsbury Publishing.

Kershner, R., Mercer, N., Warwick, P., & Kleine Staarman, J. (2010). Can the interactive whiteboard support young children's collaborative communication and thinking in classroom science activities? *International Journal of Computer-Supported Collaborative Learning*, *5*(4), 359–383. https://doi.org/10.1007/s11412-010-9096-2

Littleton, K., & Mercer, N. (2013). *Interthinking: Putting talk to work*. Routledge.

Ludvigsen, K., Ness, I. J., & Timmis, S. (2019). Writing on the wall: How the use of technology can open dialogical spaces in lectures. *Thinking Skills and Creativity*, *34*, 100559. https://doi.org/10.1016/j.tsc.2019.02.007

Lund, A., & Hauge, T. E. (2011). Designs for teaching and learning in technology-rich learning environments. *Nordic Journal of Digital Literacy*, *6*(4), 258–272. https://doi.org/10.18261/1891-943X-2011-04-05

Major, L., Warwick, P., Rasmussen, I., Ludvigsen, S., & Cook, V. (2018). Classroom dialogue and digital technologies: A scoping review. *Education and Information Technologies*, *23*(5), 1995–2028. https://doi.org/10.1007/s10639-018-9701-y

Mercer, N., Dawes, L., Wegerif, R., & Sams, C. (2004). Reasoning as a scientist: Ways of helping children to use language to learn science. *British Educational Research Journal*, *30*(3), 359–377. https://doi.org/10.1080/01411920410001689689

Mercer, N., Hennessy, S., & Warwick, P. (2019). Dialogue, thinking together and digital technology in the classroom: Some educational implications of a continuing line of inquiry. *International Journal of Educational Research*, *97*, 187–199. https://doi.org/10.1016/j.ijer.2017.08.007

Mercer, N., & Littleton, K. (2007). *Dialogue and the development of children's thinking: A sociocultural approach*. Routledge.

Mercer, N., Wegerif, R., & Dawes, L. (1999). Children's talk and the development of reasoning in the classroom. *British Educational Research Journal*, *25*(1), 95–111. https://doi.org/10.1080/0141192990250107

Mercier, E., Rattray, J., & Lavery, J. (2015). Twitter in the collaborative classroom: Micro-blogging for in-class collaborative discussions. *International Journal of Social Media and Interactive Learning Environments*, *3*(2), 83–99. https://doi.org/10.1504/IJSMILE.2015.070764

National Academies of Sciences, Engineering, and Medicine. (2018). *How people learn II: Learners, contexts, and cultures*. The National Academies Press. https://doi.org/10.17226/24783

Norwegian Data Protection Services. (n.d.). *Norsk senter for forskningsdata*. NSD. https://nsd.no

Omland, M., & Rødnes, K. A. (2020). Building agency through technology-aided dialogic teaching. *Learning, Culture and Social Interaction*, *26*, 100406. https://doi.org/10.1016/j.lcsi.2020.100406

Omland, M. (2021). Technology-aided meaning-making across participation structures: Interruptions, interthinking and synthesising. *International Journal of Educational Research*, *109*, 101842. https://doi.org/10.1016/j.ijer.2021.101842

Organisation for Economic Co-operation and Development. (2018). *The future of education and skills education 2030*. OECD Publishing. https://www.oecd.org/education/2030-project/about/documents/E2030%20Position%20Paper%20(05.04.2018).pdf

Preston, J. P., Jakubiec, B. A., Jones, J., & Earl, R. (2015). Twitter in a Bachelor of Education course: Student experiences. *LEARNing Landscapes*, *8*(2), 301–317. https://doi.org/10.36510/learnland.v8i2.710

Rasmussen, I., & Hagen, Å. (2015). Facilitating students' individual and collective knowledge construction through microblogs. *International Journal of Educational Research*, *72* (1), 149–161. https://doi.org/10.1016/j.ijer.2015.04.014

Rasmussen, I. (2012). Trajectories of participation: Temporality and learning. In N. M. Seel (Ed.), *Encyclopedia of the sciences of learning* Part 20/T. (pp. s3334–s3337). Springer.

Scardamalia, M., & Bereiter, C. (2006). Knowledge building: Theory, pedagogy, and technology. In K. Sawyer (Ed.), *Cambridge handbook of the learning sciences* (pp. 97–118). Cambridge University Press.

Smørdal, O., Rasmussen, I., & Major, L. (2021). Supporting classroom dialogue through developing the Talkwall microblogging tool: Considering emerging concepts that bridge theory, practice and design. *Nordic Journal of Digital Literacy 16*(2), 50-64 . https://doi.org/10.18261/.1891-943x-2021-02-02

Tang, Y., & Hew, K. F. (2017). Using Twitter for education. Beneficial or a waste of time? *Computers & Education*, *106*, 97–118. https://doi.org/10.1016/j.compedu.2016.12.004

Utdanningsdirektoratet. (2018, November 26). *Hva er fagfornyelsen?* [What is the new Norwegian Curriculum?]. Utdanningsdirektoratet. https://www.udir.no/laring-og-trivsel/lareplanverket/fagfornyelsen/nye-lareplaner-i-skolen

Utdanningsdirektoratet. (2020). *Overordnet del – Verdier og prinsipper for grunnopplæringen [Norwegian Curriculum – Norms and guidelines]*. Utdanningsdirektoratet. https://www.udir.no/lk20/overordnet-del/

Warwick, P., Cook, V., Vrikki, M., Major, L., & Rasmussen, I. (2020). Realising "dialogic intentions" when working with a microblogging tool in secondary school classrooms. *Learning, Culture and Social Interaction*, *24*, 1–19. https://doi.org/10.1016/j.lcsi.2019.100376

Wegerif, R., Mercer, N., & Major, L. (2019). Introduction to the Routledge *international handbook of research on dialogic education*. In N. Mercer, L. Major, & R. Wegerif (Eds.), *The Routledge international handbook of research on dialogic education* (pp. 1–8). Routledge.

Zhang, J., Scardamalia, M., Reeve, R., & Messina, R. (2009). Designs for collective cognitive responsibility in knowledge-building communities. *Journal of the Learning Sciences*, *18*(1), 7–44. https://doi.org/10.1080/10508400802581676

Appendix A1. Talk rules

Original (Norwegian)

(1) Jeg har respekt for andres meninger.
(2) Jeg er forberedt på å forandre mening, det viser at jeg lytter til gode argumenter.
(3) Jeg stiller spørsmål ved forklaringer jeg ikke synes er gode nok.
(4) Alle skal bli spurt om hva de mener.
(5) Jeg ser og lytter til personen som snakker.
(6) Gruppen diskuterer alle alternativer før de bestemmer seg.

   English translation

(1) Show respect for others' opinions.
(2) Prepare to change your mind, which means that you are listening to good arguments.
(3) Ask questions if you think someone's explanations are not good enough.
(4) Ask everyone for their opinion.
(5) Look at and listen to the person who is talking.
(6) The group discusses all alternatives before making a decision.