External Dimensions of In-the-Moment Teacher Decision-Making

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Abstract

The dynamic nature of teaching often presents schoolteachers with unforeseen challenges that need to be resolved through in-the-moment decision-making. Faced with the pressures of settling challenging teaching situations, teachers must find ways to respond that fit the specific practical requirements of their classrooms. The research literature on teacher decision-making has, however, maintained a one-sided focus on internal psychological processes, omitting its external dimensions.

This study develops a theoretical perspective that accounts for external dimensions of teacher decision-making, focusing on how enactment of decisions requires the use of external support in the form of physical objects, writing, visual depictions, spoken language, gestures and sounds. The study focuses on two interrelated research questions; the first concerns the function of teachers' use of external supports during in-the-moment decision-making; and the second relates to the role of physical and cultural circumstances in shaping teachers' use of external supports. The data includes detailed lesson observations and post-lesson interviews with five teachers from an English secondary school, as well as documents and observations of staffroom meetings. The data is analysed by 'zooming in' on instances of in-the-moment teacher decision-making, unpacking the moment-by-moment unfolding of these instances, using analytical procedures which were developed on the basis of the cultural-historical method of double stimulation.

Drawing on cultural-historical research traditions, the study shows how the teachers relied on strings of artefacts, by means of which they redesigned problematic student tasks to resolve emerging challenges. The teachers' enactments of decisions were constrained and enabled by the artefacts they were able to produce in-the-moment; and the specific physical and cultural arrangements of their teaching situations were instrumental in making some artefacts more useful than others. The thesis develops theoretical concepts for understanding teachers' use of external supports during in-the-moment decision-making, presenting a conceptual model that helps shed light on what makes the external enactment of in-the-moment teacher decisions practical.

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1 Introduction

Resolving challenging classroom situations through in-the-moment decisions is a core part of teaching. The everyday work in schools puts teachers at the centre of a range of demands. The individual teacher often becomes a 'broker' of interests (Lampert, 1985, p. 190), needing to attend to multiple, and sometimes seemingly contradictory goals (Hargreaves, 2003). Contingencies arise from the logistics and social complexities of organising and leading student activities (Doyle, 1977) and from attempts to adjust tasks to the ways students engage with subject matter content (Stylianides & Stylianides, 2014; Wood & Wood, 1996). School teaching often unfolds at a fast pace, giving teachers limited time to choose a course of action (Doyle, 2006). Understanding more fully teachers' in-the-moment decision-making is necessary because their job is '*complex*, *uncertain*, and peppered with *dilemmas*' (Clark, 1988, p. 9, emphasis in original). A better understanding of what dealing with challenging teaching situations requires from teachers is critical to the preparation of teachers and central to efforts to help them in their work.

This study zooms in on the ways teachers resolve challenging teaching situations, seeking to identify and understand more clearly the external supports they use, focusing on the ways teachers rely on physical objects, writing, visual depictions, spoken language, gestures and sounds in their enactment of in-the-moment decision. By focusing directly on classroom in-the-moment teacher decision-making, this thesis seeks to develop new general insights that are relevant to initial teacher education, continuous professional development, school management, school change implementation and educational technology design. Instead of structuring the study according to

assumptions from a particular applied domain, the focus on teacher decision-making was part of an attempt to centre the enquiry on what matters to teachers in the classroom. Rather than, for example, evaluating the outcomes of a particular initial teacher education pedagogic strategy, the study explores more general questions about what teachers draw on to resolve challenging teaching situations.

Several visits to the secondary school that eventually became the research site offered access to their weekly Friday morning professional development sessions. These sessions were led by teachers who facilitated group discussions and who brought ideas for the other teachers to try out in their classrooms. Fascinated by these collaborative endeavours, the initial research plan was to study how ideas travelled from the Friday morning meetings into the teaching of the individual teachers. The initial research plan thereby unintentionally followed the logic of the professional development sessions, which largely sought to make teachers apply specific pre-designed teaching techniques.

In developing this research project, it soon became clear that the pursuit of new insights was better served by taking a step back from applied questions about specific strategies for supporting teachers. Rather than waiting to see the application of specific ideas from professional development sessions, the study was instead designed to shed light on the range of different external supports that teachers draw on during challenging teaching situations (physical objects, writing, visual depictions, spoken language, gestures and sounds). The rationale was that a robust understanding of the needs of teachers should be the foundation for ideas about how to support them – and not the other way around. Distancing the enquiry from established assumptions about what teachers would find helpful opened up this project's exploration of the dynamics of in-the-moment teacher decision-making, making it possible to take teachers' use of external supports as a topic in its own right.

Early visits to the research site school made visible how the teachers valued actionable ideas such as techniques or tools that they could apply directly in their teaching, and which would fit the circumstances of their classrooms and serve the specific needs of their students. While the teachers were also interested in discussing more general ideas about teaching, there was a clear emphasis on what to *do* in the classroom. Pressured for time and needing to attend to a large number of different commitments, the teachers seemed, at least in part, to operate according to what Doyle has called a practicality ethics in teacher decision-making: the tendency to evaluate changes according to how easily they can be converted into actionable procedures (instrumentality); how well changes fit with the specific circumstances of their classrooms (congruence); and the amount of time and resources they demand from the teachers (cost) (Doyle & Ponder, 1977; Janssen, Westbroek, Doyle, & Van Driel, 2013).

The early attention to the importance of practicality and the emphasis on relevance to the everyday work of teachers highlighted a key theme that runs throughout this thesis: support that is intended to help teachers should not only be beneficial in theory; it needs to be practically applicable when challenges arise in the classroom. In order to explore the practical side of resolving challenging teaching situations, and in order to understand better what support teachers find useful, this study focused on resources that were directly involved in the enactment of in-the-moment decisions. The research strategy was to focus on outward teacher action to identify the external supports (physical objects, writing, visual depictions, spoken language, gestures and sounds) teachers make use of when they enact decisions.

The focus on external supports that are directly implicated in the enactment of in-the-moment teacher decision offered a novel perspective on the practicalities of what it takes to teach. Viewing in-the-moment teacher decision-making in terms of outward

enactment of actions foregrounded aspects that have received very limited attention in the research literature on teacher decision-making. As will be detailed in the next chapter, the main strands of the research that engage with the topic of teacher decision-making have focused on its inner psychological dimensions. Teacher decision-making has typically been studied as either information processing (Borko & Shavelson, 1990; Feldon, 2007), reflection-in-action (Schön, 1983), inner dialogue (Lampert, 1985) or sense-making (Schmidt & Datnow, 2005). All of these approaches offer insights into the ways teachers make decisions during their teaching. Focusing only on the thinking that goes into resolving challenging teaching situations, however, leaves out thorough examination of what teachers do 'outside their heads', portraying in-the-moment decision-making as a process where teachers rely only on cognitive or psychological resources. The discussion of teacher decision-making thereby runs the risk of bypassing any questions about the importance and practicality of the external supports with which teachers achieve their decisions.

The interest in teachers' use of external supports was further strengthened by early iterations of data analysis using pilot study data. Action-by-action analyses of instances of in-the-moment teacher decision-making indicated that the enactment of decisions involved an intricate orchestration of a range of different external supports. Based on a refinement of this kind of analysis, the findings chapters in this thesis document how strings of different supports were drawn into the enactment of in-the-moment teacher decisions. To illustrate the extensive reliance on external supports that becomes visible through this kind of fine-grained analysis, an example is presented below. The example highlights the kind of use of external supports that is the topic of this thesis.

Example of the use of external supports

The example below illustrates the outcome of interpreting one instance of in-the-moment teacher decision-making from the classroom of the mathematics teacher Richard. Apart from making visible Richard's use of external supports, the example also indicates the kind of analysis that is the core of this research project, and which will be detailed in the next chapters. The example is drawn from the first lesson of the day on a Thursday morning at the beginning of December. Most of the students had already arrived before the lesson started. The students were a year eleven class, thus around 15-16 years old and approaching their final examination in the summer.

Richard was waiting for the students as they arrived into his mathematics classroom. Students were greeted by a PowerPoint slide projected on a whiteboard, showing the seating plan. After a short while, Richard replaced it with a slide presenting a 'starter' task which the students were meant to start working on immediately as they got seated. As he would usually do, Richard talked to those students who arrived slightly before the rest of the class. This morning he used this time as an opportunity to mention and receive homework, talking to specific students one-on-one.

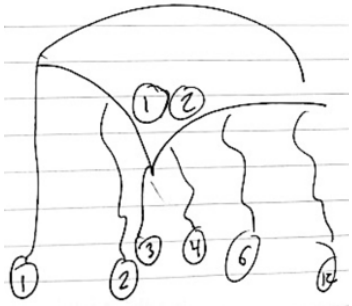
The use of a 'starter' task, like the one presented on the PowerPoint slide, was typical of Richard's lessons and it was a common way to start lessons also for other teachers in the school. In this starter task, the students were asked to find the 'square factors' of a list of ten different numbers. The task was part of going through material that Richard had presented the day before. The overall topic was simplification of 'surds', irrational numbers that can be written in square root form and that can be simplified by finding multiplication factors. For example, the square root of 126 can be simplified as three times the square root of 14 (because $\sqrt{126} = 3\sqrt{14}$).

In this lesson, the progression of the starter task became problematic momentarily for Richard. He was oriented towards enabling the students to simplify and do calculations with surds. This orientation related directly to wanting to prepare the students for their exams. According to Richard, the task was intended as a way to practise "essential exam knowledge" that he had introduced the day before. By walking among the students, looking at the calculations in their books and talking to them individually, Richard found that the students were struggling to do the calculations. Assessing this issue, which challenged the progression of the starter task, Richard diverted from his plan. Instead of letting the students work independently, he decided to help them understand the concepts of 'factors' and 'square numbers'.

Table 1 below presents the sequence of the lesson during which Richard enacted his in-the-moment decision. The first column of Table 1 contains an observation excerpt with a row for each of Richard's actions during his enactment of the decision. The second column formulates the orientations that Richard was interpreted to be pursuing during each action. The last column on the right lists the external supports that Richard was interpreted to be using in each action.

Table 1: Use of External Supports During one Instance of In-the-Moment Decision-Making

Observation	**Orientations**	**External supports**
'[...] Richard stands in the front of the classroom and addresses the whole class by asking: "Who knows what they are doing?" Richard asks the students to put up their hands if they do.	1. Enabling students to simplify and do calculations with surds.	<u>Spoken language:</u> - Question and instruction assessing understanding of task.
One student puts up a hand and then another student puts up a hand. More students put up their hands, hesitating a lot. Richard: "I can see six half hands."	1. Enabling students to simplify and do calculations with surds.	<u>Gesture:</u> - Students' hands. <u>Spoken language:</u> - Assessment of number of hands.

Richard says that he has drawn a fish as he is building up the following drawing on the board:  One student says that it is not a fish. Someone suggest that it is a jelly fish. Richard draws the tentacles as he is talking. Richard explains what a "factor" is by having first 4 tentacles and saying that it is what 12 can be divided by, writing first 12 to the right and 1 to the left. He then writes 2 and 6 and adds two more tentacles in the middle writing 3 and 4. Richard says that these are "factors".	1. Enabling students to simplify and do calculations with surds. 2. Help students understand factors.	Visual depiction: - The 'jelly fish' drawing. Written language: - Numbers on 'jelly fish' drawing. Spoken language: - Explanations of what he draws and writes.
One student then says: "I get factors; it is the square that confuses me." Richard says that that is what he will move on to now.	1. Enabling students to simplify and do calculations with surds. 3. Help students understand square numbers.	Spoken language: - Student's question. - Statement that the next part is about squares.
Richard writes a vertical list of numbers on the right-hand side board: 1, 4, 9, 16, 25. While writing the numbers, Richard says 1 times 1 is 1, 2 times 2 is 4, 4 times 4 is 16 etc. Richard says that these are square numbers and explains further.	1. Enabling students to simplify and do calculations with surds. 3. Help students understand square numbers.	Written language: - List of numbers written on the board. Spoken language: - Verbal calculation. - Statement that these are square numbers. - Explanation.
Richard then asks: "How do I decide" whether one of these numbers is a factor? One student: "Divide." Richard says: You divide. Richard stops explaining. Most of the students are now writing in their books or looking up on the board where the 'starter' task slide is still on. [...]' (After this point, Richard lets the student work independently on the starter task.)	1. Enabling students to simplify and do calculations with surds. 2. Help students understand factors. 3. Help students understand square numbers.	Spoken language: - Question about calculation procedure. - Student's answer. - Repetition of student's answer.

As outlined in Table 1 above, Richard enacted his in-the-moment decision about the 'starter' task by pausing it to explain factors and square numbers respectively. This unplanned insertion of these two short sub-tasks did not create a lot of problems for

Richard. In reflecting on the incident in a post-lesson interview, Richard portrayed the enactment of the decision as entirely unproblematic: "Oh, I have just discovered that students can't remember what a factor is, I'm gonna spend a couple of minutes explaining and reminding them what factors are." However, although seemingly effortless, Table 1 makes visible that Richard relied on a number of external supports to enact his in-the-moment decision. As highlighted in Table 1, Richard skilfully used different external supports to pause the 'starter' task and to insert explanations of factors and square numbers. Using these external supports, Richard quickly resolved the challenges that threatened the starter task, utilising these resources for the enactment of his decision to pause the task and explain factors and square numbers.

Research questions

It was examples like the one above that pointed to the importance of teachers' use of external supports during in-the-moment teacher decision-making. The findings chapters, chapters six and seven, will present many more instances of in-the-moment decision-making, exploring and conceptualising the use and role of external supports. As the literature review in the next chapter highlights, attention to such external dimensions of in-the-moment decision-making is limited in the research literature, leaving no well-established framework for exploring this topic. Seeking to provide the basis for systematic investigation of the topic, this thesis seeks to develop a theoretical framework for understanding and exploring further the role of, and conditions for, teachers' use of external support during in-the-moment decision-making.

The aim of the research project presented in this thesis is to extend our understanding of in-the-moment teacher decision-making by exploring the role of

teachers' reliance on external supports. It was guided by the following two interrelated research questions:

1. *What role does schoolteachers' use of external supports play in their enactment of in-the-moment decision-making?*
2. *How do physical and cultural circumstances of teaching situations enable and constrain schoolteachers' use of external supports during in-the-moment decision-making?*

The broad definition of external supports, which will be discussed in the theory chapter, cuts across different modalities and includes teachers' use of physical objects, writing, visual depictions, spoken language, gestures and sounds. External supports thus refer to the broad range of means that teachers use in order to enact instruction. In the context of this study, they are seen as 'supports' in the sense that they help teachers enact decisions. As will also be specified in the theory chapter, in-the-moment decision-making refers to any situations where teachers become unsure about how to proceed with an aspect of their teaching, and where they nevertheless, in that same teaching session, find a course of action through which they attempt to resolve the problem.

The first research question targets directly the need for a thorough examination of the role of external supports in teachers' in-the-moment decision-making. It draws the enquiry towards an exploration of the ways in which the use of external supports helps teachers enact their decisions. As evident from the example above, Richard's use of external supports was central to his skilful resolution to the challenging teaching situation. Research question one formulates the aim to conceptualise in greater detail the function of external supports for teachers during in-the-moment decision-making.

The second research question guides the attention towards the context of teachers' use of external supports. It focuses the inquiry on the ways specific

circumstances make the enactment of some decisions easier and more appropriate than others. As will be discussed in the theory chapter, the second research question is motivated by the following conjecture: if external supports are needed in the enactment of in-the-moment decisions, then any circumstances that make external supports operational or practically useful are also likely to have bearings on the decision-making.

A cultural-historical theoretical lens

This study drew on a cultural-historical research tradition (Cole, 1996; Daniels, 2012b; Hedegaard, 2012a; Valsiner, 2000; Wartofsky, 1979; Wertsch, 2007) to address the research questions. Opening up the topic required a perspective that could account for the external 'doing' of in-the-moment teacher decision-making without disconnecting it from psychological processes and individual subjective perspectives of teachers. Recasting the topic of teacher decision-making to include the role and context of teachers' use of external supports was enabled through the cultural-historical insistence that internal and external aspects of action are mutually constituting. This key feature of the cultural-historical perspective will be detailed in the theory chapter, which will lay out the basic concepts drawn on in this study.

The cultural-historical perspective made it possible in this study to direct attention towards the external enactment of teacher in-the-moment decisions without losing sight of the intentions that motivated the teachers because the cultural-historical research tradition offers concepts that draw attention to the 'coming together' of internal and external. As will be detailed in the theory chapter, outward actions are in this tradition seen as purposive and goal-oriented, an idea which was given a key role in this study through the focus on the concept of motive-orientations (Hedegaard, 2012a). It was through the adaptation of these theoretical resources that it became possible to

analytically capture the objectives that teachers were trying to satisfy when enacting in-the-moment decisions, showing such enactment as sets of meaningful actions rather than merely external behaviour, and highlighting the intimate connection between internal and external by focusing on how enactment of decisions were driven by intentions to change the ongoing classroom activities.

The cultural-historical research tradition offered particularly well-suited theoretical resources for adding an external dimension to our understanding of teacher decision-making, a phenomenon which might otherwise be regarded as an exclusively internal psychological process. Through the key concept of double stimulation (Engeström, 2007; Valsiner, 2000; Vygotsky, 1987), which will also be discussed in the theory chapter, the cultural-historical perspective opened up the analysis to new insights by foregrounding the 'coming together' of, on the one hand, the intentions or motivational priorities that teachers were trying to achieve in the decision-making situations and, on the other, the external means for realising those intentions or priorities within specific situations.

The cultural-historical lens furthermore provided a way to thoroughly conceptualise the means with which teachers enact in-the-moment decisions. Through the key concept of artefact mediation (Cole, 1996; Hutchins, 1997; Wartofsky, 1979; Wertsch, 2007), the cultural-historical perspective presented a theoretically robust way to examine the role of external supports (research question one), while at the same time maintaining a holistic analysis which includes supports pertaining to different modalities: physical objects, writing, visual depictions, spoken language, gestures and sounds. As with the concepts of motive-orientations and double stimulation, the idea of artefact mediation similarly offered a way to draw the analytic attention towards the crux of the mutual constitution of inner and outer dimensions of in-the-moment teacher

decision-making. Because of the emphasis in the cultural-historical perspective on the tool-like character of mediating artefacts, it lent itself particularly well to the question about the function of external supports in teachers' resolutions to difficult teaching situations.

The aim expressed in research question two concerned the relationship between teachers' use of external supports and the physical and cultural circumstances of decision-making situations. The project hence also required rich conceptual resources for analysing the role of social context and its relation to individual action. In this respect the cultural-historical perspective was also particularly well-fitted for the purposes of this study. As will be detailed in the theory chapter, highlighting the idea of context as interweaving (Cole, 1996) and describing the concept of activity settings (Hedegaard, 2012a, 2012b), action is seen as embedded in social and collective activities that have histories and, as a result, take place among particular cultural arrangements and expectations. This cultural-historical view opens up a nuanced analysis of the role of social context, where context is not merely seen as an external constraint to the action of the individual, but rather as a source of both demands and opportunities for an individual's participation in and contribution to ongoing activities.

Study outline

Because the external dimensions of in-the-moment teacher decision-making have received little attention, the development of appropriate research methods and analytical procedures was a key part of addressing the research questions of this study. The study focused on five case teachers through more than forty school visits to an English secondary school. Teachers were chosen across subjects and levels of experience to allow for maximum variation between cases, while maintaining the advantage of rich

context understanding by choosing teachers from the same school. The data collection strategy was established and adapted in the early phases of the study, choosing a focus on detailed data on critical teaching incidents (classroom observations and post-lesson interviews) and rich context data about the school (staffroom observations, interviews and documents). Through trials of data analysis, the method of double stimulation, derived from a cultural-historical research tradition, was developed into an analytical strategy for identifying teachers' use of external supports; a strategy coherent with the project's theoretical emphasis on the concept of artefact mediation.

Detailed analyses of the five case teachers challenged and refined the theoretical framework, enabling evaluation of its adequacy and relevance for noticing and understanding the role of teachers' use of external supports during in-the-moment decision-making. The aim was to specify concepts that allowed a detailed, coherent and relevant description of the case teachers' use of external supports and the physical and cultural circumstances that enabled and constrained their support use. The analysis relied on differences in support use, both within cases and between cases. The rationale was that emerging concepts and categories should account well for both similarities and differences without compromising the level of detail of the case descriptions.

The thesis addresses its two research questions by presenting and discussing the conceptualisation that was developed and refined in the data analysis. The study thereby offers concepts for understanding the function of teachers' use of external supports during in-the-moment decision-making (research question one) and the ways physical and cultural circumstances shape the use of external supports (research question two).

The next chapter reviews the literature on in-the-moment teacher decision-making, examining the ways in which this literature has addressed the role of external supports in teachers' in-the-moment decision-making. *Chapter three* presents the

theoretical framework of the research project, discussing the concept of artefact mediation and how it informs this project's conceptualisation of teachers' resolutions to uncertain teaching situations. *Chapter four* details the research design, data collection methods and data analysis procedures used in the research project. *Chapter five* provides details about the five case teachers and the school setting, thereby establishing necessary background information as a basis for the subsequent two findings chapters.

Chapter six addresses directly research question one about the function of external supports during in-the-moment decision-making. *Chapter seven* presents the findings relating to the second research question about the role of physical and cultural circumstances in enabling and constraining use of external supports. *Chapter eight* discusses the findings, arguing that the study makes visible the importance of accounting for the practicalities of teacher decision-making without psychologizing these processes, highlighting the need to recognise the use of external artefacts as part of what it takes to teach, and pointing to potential implications of the theoretical developments for practitioners. *Chapter nine* concludes the thesis with a summary of the key contributions of the study, its limitations and directions for future research.

2 Literature Review

This literature review chapter brings out how only few studies have considered the ways teachers make use of and contribute to their immediate environment as part of enacting in-the-moment decisions. The chapter presents the results of what started as an initial curiosity about the lack of discussions about the external environment in the literature on teacher decision-making. The chapter thereby expands on a key motivation for this research project: the limited attention in the research literature to external dimensions of in-the-moment teacher decision-making.

The review briefly presents the main approaches to the study of teacher decision-making, highlighting how these perspectives all focus on cognitive or mental aspects. Subsequently, the second and core part of the chapter presents an overview of studies that depart from the dominant focus on inner psychological phenomena. As will be detailed, an extensive literature search identified these exceptions, making it possible to bring to the fore conclusions in the literature about teachers' use of external supports during decision-making. The latter section of this chapter assesses the need for theory development, thereby presenting the background for this theory development project, and providing the basis for the subsequent theory chapter.

2.1 Main Approaches to the Study of Teacher Decision-Making

The research project presented in this thesis deliberately adopted a perspective that is different from the main approaches to the study of teacher decision-making. As will be described briefly below, the most common ways to understand teacher decision-making

is by focusing on either cognitive information-processing, reflection-in-action, inner mental dialogues or sense-making.

Cognitive information processing accounts have studied how teachers reduce and filter complex information in order to arrive at decisions. These studies have drawn on the insight from cognitive psychology that a person's cognitive capacities are limited and therefore highly selective in the intake and processing of information (March & Simon, 1958; Simon, 1947). Cognitive information processing accounts have offered several concepts to explain how teachers' rapid processing of information is achieved. The most central of these concepts has perhaps been the notion of schemata (Berliner, 1987; Borko & Livingston, 1989; Borko, Roberts, & Shavelson, 2008; Leinhardt & Greeno, 1986; Peterson & Comeaux, 1987; Shavelson & Stern, 1981; Stern & Shavelson, 1983). Schemata are learned structures of knowledge that help a person quickly summarise information on the basis of generalisations (Borko & Livingston, 1989).

Different types of schemata have been suggested to structure teacher decision-making. For example, Leinhardt and Greeno (1986) suggest that teachers reduce the complexity of classroom decisions by relying on 'activity structures' and 'operational routines'. According to Leinhardt and Greeno, 'activity structures' allow teachers to recognise and organise information according to subunits of a lesson, 'such as checking homework, presenting new material, getting problems worked at the board, having independent seatwork done, and so on' (p. 76). Operational routines are, on the other hand, 'small, socially scripted pieces of behavior', for example handing out paper, that eases the cognitive load of realising 'activity structures' (p. 76).

The idea that teachers' information processing follows certain learned structures to reduce cognitive load has also led researchers to propose a number of other

explanatory concepts. For example, Shavelson and Stern (1981) suggest that teachers select and integrate information on the basis of attributions and heuristics. They contend that attributions structure judgements of causes, for instance causes of student achievement, while heuristics help teachers select and classify salient information, judge probabilities of events, and guide the revision of initial judgements. Yet another example is Feldon's (2007) dual-process model of teacher decision-making which hypothesises two general modes of information processing: a controlled, slow, conscious pathway; and an automatic, fast, non-conscious pathway that relies 'on heuristics and generalized and stereotypic schematic representations' (p. 124). Stressing the goal-oriented nature of teacher decision-making, Schoenfeld (1998, 2011) argues that teachers' processing of information happens as an interplay between knowledge, beliefs and goals that are activated in specific teaching contexts.

Reflection-in-action perspectives have drawn on the work of Schön (1983, 1987). Rather than seeing professional decision-making as a matter of applying specific rules and theories, Schön draws attention to the ways practitioners experiment with and reflect on features of their work that are highly situation-specific. According to Schön, reflection-in-action is a process whereby practitioners explicate and alter their implicit understandings of challenging situations at work. The reflection-in-action perspective has been hugely influential in the study of teacher reflection and its potential as a pedagogic strategy in initial teacher education and continuing professional development (Bengtsson, 1995; Calderhead, 1989; Colton & Sparks-Langer, 1993; Eraut, 1995; Handal & Lauvas, 1987; Hatton & Smith, 1995; Mackinnon, 1987; Smyth, 1989; Zeichner & Liston, 2014). This strand of research has, however, concentrated on outside-the-classroom reflection and not on reflection in-the-moment during lessons.

Inner dialogue accounts portray decision-making processes as internal conversations that teachers have with themselves. They thereby come close to Schön's (1983) perspective in the sense that the dialogue is a type of reflection. The inner dialogue accounts, however, emphasise how the process progresses as a private interchange of mental turns of verbal dialogue. Lampert (1985), for instance, reports on her own experiences as a teacher, describing how she engaged with teaching dilemmas through a process of arguing with herself. Based on this analysis, Lampert stresses that internal argumentation allows for ongoing coping and that it counters the negative consequences of forced choices between predefined alternative commitments. Wagner (1987) also analyses teacher classroom thinking about dilemmas in terms of inner dialogue, reporting that certain content and structures of such inner dialogue can result in a deadlock of teachers' thought processes.

Researchers that have taken a *sense-making* perspective have focused on how teachers interpret and incorporate new events into their existing frameworks of understanding. This perspective has been adopted for the study of teachers' responses to school reform, analysing teachers' understandings, emotions and attitudes relating to organisational or curriculum change (Allen & Penuel, 2015; Coburn, 2002; Cohen, 1990; Hill, 2001; Jennings, 1996; Schmidt & Datnow, 2005; Spillane, Reiser, & Reimer, 2002). Due to the focus on school reform, however, these studies have investigated long-term sense-making processes where teachers have interpreted and negotiated school change in relation to their existing frameworks of understanding. Thus, these studies have not brought the sense-making approach to bear on the micro-level processes of in-the-moment classroom decision-making.

While the most influential approach to the study of teacher decision-making has been the study of cognitive information processing, all of the approaches above have

provided important perspectives on the internal psychological processes of teacher decision-making. Considering the exclusive focus on the mental aspects of teacher decision-making, however, makes visible the potential for an alternative line of enquiry. Because of the attention to cognitive information processing, reflection-in-action, inner dialogue and sense-making, the research literature largely bypasses questions about the role of teachers' use of external supports during decision-making.

The research project presented in this thesis is the result of taking an alternative route, deliberately shifting the focus towards teachers' use of external supports. The first step in presenting those endeavours is the following examination of studies which depart from the dominant focus on internal psychological phenomena in the literature, and which have drawn some conclusions about the role of external supports in teacher in-the-moment decision-making.

2.2 Role of External Supports in Teacher Decision-Making

Because the above-mentioned dominant approaches to the study of teacher decision-making have focused on internal psychological processes, they do not provide insights specifically about the role of external supports. To further assess this tendency in the literature, and in order to take note of findings that do provide insights specifically about external supports, this section presents the results of an extensive literature search. The search sought out studies that include conclusions about the extent to which outward enactment of in-the-moment teacher decisions relies on material resources and whether the use of such resources plays a role in teacher decision-making. As will become apparent below, the search covered a diverse terrain of research and involved extensive screening of potentially relevant studies, finally locating 19 studies that, in

different ways, included inferences about teachers' use of external supports during in-the-moment decision-making.

Literature search

The literature search probed into an area which is not well-established and which does not offer consolidated constructs which would locate all relevant studies. Rather, the search spanned many different types of research agendas, where the pursuit of other topics (for example curriculum implementation, information and communications technology in teaching or teaching of science concepts) had led researchers towards analyses and conclusions about external dimensions of teacher decision-making. The capturing of such studies in the literature search therefore relied on a very broad range of search terms.

The first step was to include the range of synonyms that would locate studies that mention some form of in-the-moment decision-making in their titles or abstracts. Secondly, and more challenging, studies were only relevant if they made conclusions that specifically emphasised the role of external supports. Due to the interest in studies that highlight the external dimensions of teacher decision-making, the breadth of search terms was meant to capture studies with such emphasis, targeting terms that could potentially describe material entities that were useful for deciding teachers.

Table 2 below outlines the search terms. The three groups of search terms were combined using the 'AND' function, thereby turning out studies which mention one or more terms from each of the three of the categories. As shown in Table 2, truncations (*) and different grammatical variations were used to capture different versions of the same search terms, seeking to achieve an inclusive initial search that could then be screened. The search included article titles, abstracts and keywords.

Table 2: Search Terms Grouped According to Search Target

Search target	**Search terms**
Schoolteachers	teacher OR teachers OR schoolteacher
Decision-making	dilemma* OR improvise* OR improvisation OR adaption* OR adapt OR adaptive OR decide* OR adjust* OR redesign* OR replan* OR tweak* OR ambiguit* OR decision OR decisions OR "decision making" OR "decision-making" OR "make decisions" OR negotiate OR negotiating OR negotiated OR negotiates OR uncertaint* OR judgement* OR sensemaking OR "sense making" OR "making sense" OR "reflection-in-action" OR experimentation* OR steer* OR handle OR handling OR "problem-solving" OR "problem solve" OR "problem solving" OR resolve* OR resolving OR "settle on" OR "settling on" OR "settles on" OR "settled on" OR reconcil* OR responsiveness OR responsive OR "deal with" OR doubt OR unanticipated OR hesitation OR hesitancy OR vacillation* OR quandry OR quandries OR unsure OR unsureness
External supports	material OR materiality OR stuff OR tangable OR mundane OR concrete OR corporal OR visible OR visibility OR hearable OR tangible OR bodily OR actual OR temporal* OR physical* OR object OR objects OR equipment OR tool* OR utensil* OR instrument OR instruments OR thing* OR appliance* OR device* OR apparatus OR appliance* OR aid* OR gear OR supplies OR facility OR facilities OR artefact* OR artifact* OR entity OR entities

Using the search terms in Table 2 above, a search for peer-reviewed journal articles was conducted on five different databases to capture the breadth of research on teaching: ERIC, British Education Index, Web of Science, Scopus and PsychInfo. The search was conducted the 1st November 2017. The search was limited according to the focus on teachers and teaching, searching only among studies that had been classified by the databases as relating to the overall topics of teaching and teaching methods. Details about these database limits are included in Table 19 on p. 295 in the appendices. The ERIC database yielded 1533 hits; British Education Index 622 hits; Web of Science

2247 hits; Scopus 1016 hits; and PsychInfo 845. In total across the five databases, the search gave 6263 hits of which 5173 were non-duplicates. This large number of articles was then screened according to the inclusion criteria described below.

Inclusion criteria

In the screening and selection process, the overall goal was to identify any studies that made conclusions about the role of external supports in schoolteachers' in-the-moment decision-making. In order to be included, studies therefore needed to present inferences about the *relationship between* the use of external supports and teacher decisions. Studies were therefore excluded if they made inferences *only* about teachers' use of external supports without attention to its relation to the decision-making, or if studies dealt *only* with teachers' decision-making without making conclusions about the role of the use of external supports.

The focus on schoolteachers meant that studies of early childhood education, higher education and online education were excluded, following the rationale that different age groups or entirely online interaction would mean very different teaching practices and, therefore, different roles of the use of external supports. The focus on teachers also meant the exclusion of studies that focused only on students to examine their decision-making or problem-solving. The focus on in-the-moment decision-making furthermore led to the exclusion of research on decisions that teachers make before or after their teaching, for instance during lesson planning or when marking assignments. Research on the teaching experiences of pre-service teachers (through placements or otherwise) was included because these would potentially document teaching practices approximating those of qualified teachers.

Because the literature review sought to synthesise empirical findings about the role of external supports within in-the-moment decision-making, articles were included only if they had an empirical component. The articles needed to report on the analysis of data about the ways teachers make decisions during their teaching. Empirical studies were, however, selected regardless of the data collection methods, including for example research designs that relied on interview data without observational data of the teaching they were analysing. Studies were also included regardless of their theoretical framing.

Screening and selection process

The review focused on positive results about the relationship of interest, meaning that it included findings only from studies that reported this relationship as important. Studies that did not report on this relationship do not feature as evidence that the relationship is trivial. Rather, differences between the studies were seen as a matter of different research foci, where only the included studies chose to touch upon the topic about external supports. In other words, the literature review did not seek to assess whether or not external supports are important in teacher decision-making. Instead, the review followed the assumption that external supports do play a role and it sought to explore how.

The screening of the 5173 identified studies relied on a reading of their titles and abstracts. The screening noted any articles that in their titles or abstracts pointed to the potential of containing inferences about support-decision relationships in the full text document. Hence, even if abstracts did not formulate such inferences directly, many studies still made it through the screening. That meant that the screening yielded a high

number of articles. It reduced the 5173 studies from the initial search to 353 studies, which were subjected to a more detailed reading of the full-text articles.

In the final full-text selection process, a table was used in order to organise specific excerpts from the articles. The table structured the selection process according to key aspects of the inclusion criteria, including columns for each of the following four questions: (1.) Which in-the-moment teacher decisions did they study? (2.) Which external supports were the teachers reported to be using? (3.) What inferences were they making about the functions of external supports in teacher decision-making? (4.) What methodological approaches (design, data, theoretical framing and analysis) did they use? The full-text selection process reduced the number of relevant studies considerably, yielding a total of 19 studies about which all four of the questions could be answered. The organisation of excerpts from the 19 studies included in the table provided a systematic outset for synthesising their findings about the role of external supports in in-the-moment decision-making.

Synthesis of findings about external supports

The analysis of the 19 identified studies followed Nye, Melendez-Torres and Bonell's (2016) general guidelines for qualitative meta-synthesis which emphasise the reinterpretation of findings: 'More than a broad summary, meta-syntheses do not aim merely to summarise all available data; rather, qualitative meta-syntheses present new perspectives on topics through interpreting findings from different qualitative studies to create 'third-level' findings for the advancement of both knowledge and theory' (p. 57). Reinterpretation of the identified studies was necessary because, although they all offered conclusions about relationships between external supports and teacher decision-making, the studies were very different.

The identified studies pursued different research objectives, making their inferences about teachers' use of external supports as part of accounting for different topics. They used different methods for data collection and data analysis (although almost exclusively qualitative), and they analysed different examples of in-the-moment teacher decision-making across a range of different contexts. The synthesis conducted here engaged with this complexity by attending carefully to the differences between the studies, before drawing together the findings of studies around general themes. In line with this approach, the following two sub-sections outline differences in research designs and the kinds of teacher decisions that the studies examined, before detailing their conclusions about external supports.

Research designs

Many of the studies examined in-the-moment decision-making by focusing on individual teachers, foregrounding, analysing and sometimes comparing specific critical incidents experienced by those teachers (Alvermann, 1987; Andrzejewski & Davis, 2008; Choppin, 2011; Jordan & Santori, 2015; Lagrange & Erdogan, 2009; Remillard, 1999; Wegmann, 1976), one study drawing on examples from the author's own teaching (McClain, 2002). The other main group of studies instead took specific student-teacher interaction events as their cases (G. Beauchamp, Kennewell, Tanner, & Jones, 2010; Heritage & Heritage, 2013; Korkiakangas & Rae, 2013; Mavers, 2009; Mortimer & Machado, 2000; Stieff, Ryu, & Yip, 2013; Waring & Hruska, 2011). Three studies took a slightly different unit analysis, following teachers' use of specific technological devices (Gutierrez-Santos, Geraniou, Pearce-Lazard, & Poulovassilis, 2012; Peng et al., 2009; Shirley & Irving, 2015).

Most of the studies combined direct observation of in-the-moment decision-making with supplementary data, either in the form of interviews about the teaching episodes or documents and observations of teachers' work outside teaching sessions. One study used video data to guide stimulated-recall interviews (Choppin, 2011). Exceptions to the combination of observations and supplementary data relied instead on self-report questionnaires (Talvio, Lonka, Komulainen, Kuusela, & Lintunen, 2014), interview data exclusively (Andrzejewski & Davis, 2008; Gutierrez-Santos et al., 2012; Shirley & Irving, 2015) or a combination of interviews and questionnaires (Peng et al., 2009). Three of the studies used a mixed method approach where quantitative data supplemented the qualitative data, two studies coding video transcripts (Alvermann, 1987) and observations (Remillard, 1999) to determine frequencies of different types of textbook use; and one study using questionnaire responses of 44 teachers to questions about seven imagined decision-making scenarios (Talvio et al., 2014).

Studies differed in terms of student age groups (from 6 to 17), subjects and cultural contexts. The subject mathematics was target of most of the studies (G. Beauchamp et al., 2010; Choppin, 2011; Gutierrez-Santos et al., 2012; Lagrange & Erdogan, 2009; McClain, 2002; Remillard, 1999). Other studies focused on physics (Shirley & Irving, 2015), chemistry (Mortimer & Machado, 2000; Stieff et al., 2013), science (Mavers, 2009), literacy/English (Heritage & Heritage, 2013; Korkiakangas & Rae, 2013; Waring & Hruska, 2011), biology (Peng et al., 2009) and history (Wegmann, 1976). Three studies examined teachers teaching different subjects (Alvermann, 1987; Andrzejewski & Davis, 2008; Talvio et al., 2014).

National contexts included the US (Alvermann, 1987; Andrzejewski & Davis, 2008; Choppin, 2011; Heritage & Heritage, 2013; Jordan & Santori, 2015; McClain, 2002; Remillard, 1999; Shirley & Irving, 2015; Stieff et al., 2013; Waring & Hruska,

2011; Wegmann, 1976), Brazil (Mortimer & Machado, 2000), Finland (Korkiakangas & Rae, 2013; Talvio et al., 2014), Taiwan (Peng et al., 2009), France (Lagrange & Erdogan, 2009), England (Gutierrez-Santos et al., 2012; Mavers, 2009) and Wales (G. Beauchamp et al., 2010). One of the studies examined the teaching experiences of pre-service teachers (Waring & Hruska, 2011), while the rest focused on qualified teachers.

In-the-moment decisions

In terms of the kinds of in-the-moment decision-making that the studies focused on, most of them focused on responsiveness to students' needs and engagement with tasks. In those studies, teacher decisions are reported as responses to what students said or did in their engagement with tasks (G. Beauchamp et al., 2010; Remillard, 1999) and to their thinking and understanding of subject matter content (Alvermann, 1987; Choppin, 2011; McClain, 2002); some studies focusing specifically on decisions made on the basis of continuously aggregated digital data about students' participation and progress (Gutierrez-Santos et al., 2012; Peng et al., 2009; Shirley & Irving, 2015). Two of the studies focused on behaviour management, including responsiveness to both problematic and positive student behaviour (Talvio et al., 2014; Wegmann, 1976). Two other studies focused on teachers' responsiveness to the requirements of individual students with special needs (Korkiakangas & Rae, 2013; Waring & Hruska, 2011).

Another group of studies focused on the decisions through which teachers managed moment-by-moment interaction with students. Rather than highlighting teachers' decisions about students' actions or thinking, these studies all explored communication as a collectively achieved interchange between students and teachers, emphasising the improvisation and co-creation of shared dialogue. Some of these studies examined teacher decisions about challenges to the continuation of teacher-

student interaction, including students' reluctance to participate beyond their immediate abilities (Heritage & Heritage, 2013) and student opposition to the authority of the teacher (Wegmann, 1976). Others explored teachers' negotiations with students in the shared creation of meaning about subject matter content, both in relation to the accomplishment of different dialogical opportunities for student learning (Jordan & Santori, 2015), in the generation and reconciliation of students' misunderstandings and confusion (Mortimer & Machado, 2000; Stieff et al., 2013) and in the gradual progression of student understanding through teacher demonstration (Mavers, 2009).

Finally, two studies focused on teachers' challenges in maintaining and realising their overall objectives within lessons. The first study explored dilemmas about, on the one hand, relating to and guiding students and, on the other hand, engaging in the 'risky behavior' of physically touching students (Andrzejewski & Davis, 2008, p. 779). The other study focused on the mismatch between goals of assigned tasks and students' recognition and understanding of those goals (Lagrange & Erdogan, 2009), examining the challenges of working with students' pre-established expectations about particular tasks.

Inferences about external supports and their role in teacher decision-making

Acknowledging the above-mentioned differences between the 19 studies, the following summary remains an explorative overview. It notes themes that run across the studies, rather than seeking definitive answers about the role of external supports. The notable differences between the studies, however, mean that the analysis of their findings rests on a considerable breadth when it comes to flagging up themes for further consideration. Part of this breadth is reflected in the range of different external supports the 19 studies reported to be implicated in in-the-moment teacher decision-making.

While a look across the studies showed considerable variability, each study tended to focus on one or a very small number of specific external supports. Table 3 below provides details about the external supports highlighted in each study. The table also summarises the different in-the-moment decisions that the study focused on, which was outlined in the previous section.

Table 3: External Supports Highlighted by Each of the Included Studies

Study	**Decisions**	**External supports**
(Alvermann, 1987)	Response to student understanding of subject matter content.	Textbooks.
(Andrzejewski & Davis, 2008)	Dilemmas concerning the 'risky behavior' of touching students.	Gestures.
(G. Beauchamp et al., 2010)	Response to what students say or do during tasks.	Interactive whiteboards.
(Choppin, 2011)	Response to student understanding of subject matter content.	Written teacher resource material.
(Gutierrez-Santos et al., 2012)	Use of digital information about student participation and progress.	Digital mathematics task interface and teacher interface for monitoring student work.
(Heritage & Heritage, 2013)	Response to student reluctance to participating in interaction beyond their immediate abilities.	Talk, specifically questions.
(Jordan & Santori, 2015)	Accomplishment of different dialogical opportunities for student learning.	Talk.
(Korkiakangas & Rae, 2013)	Response to requirements of individual students with special needs.	Task-related material objects, e.g. puzzles or worksheets.
(Lagrange & Erdogan, 2009)	Mismatch between goals of student tasks and students' recognition and understanding of those goals.	Spreadsheet computer software.
(Mavers, 2009)	Accomplishing gradual progression of student understanding through teacher demonstration.	Visual depictions, writing, gestures and talk.
(McClain, 2002)	Response to student understanding of subject matter content.	Digital interfaces aiding students' statistical reasoning and students' written and drawn inscriptions.
(Mortimer & Machado, 2000)	Generation and reconciliation of misunderstandings and confusion.	Talk and gestures.

(Peng et al., 2009)	Use of digital information data about student participation and progress.	Student handheld minicomputers and central teacher interface displaying student learning portfolios.
(Remillard, 1999)	Response to what students say or do during tasks.	Textbooks, verbal answers and questions, calculators, student writing and student verbal answers.
(Shirley & Irving, 2015)	Use of digital information about student participation and progress.	Student handheld graphing calculators with central teacher interface for sending data back and forth.
(Stieff et al., 2013)	Generation and reconciliation of students' misunderstandings and confusion.	Talk, specifically explanations of chemistry concepts.
(Talvio et al., 2014)	Behaviour management in response to both problematic and positive student behaviour.	Talk, specifically verbal feedback.
(Waring & Hruska, 2011)	Response to requirements of individual students with special needs.	Talk.
(Wegmann, 1976)	Upholding student-teacher interaction in the face challenges to teacher authority.	Talk.

By outlining the decisions and external supports that were examined in each of the 19 studies, Table 3 provides an outset for the following presentation on the inferences made in these articles about the relationship between teacher decision-making and the use of external supports. As will be detailed below, the studies can be grouped into five groups that each highlights a theme concerning the role of external supports in teacher in-the-moment decision-making.

One group of studies foregrounds how the use of specific external supports, during challenging teaching situations, enabled teachers to intervene and modify student actions and behaviour. Talvio et al. (2014) show how a continuing professional development course altered the ways in which 44 Finnish teachers relied on verbal feedback to guide and change student behaviour. Wegman (1976) analyses the case of one American history teacher who struggled to manage classroom behaviour,

highlighting teachers' verbal responses to student behaviour as key tools for maintaining classroom discipline. Andrzejewski and Davis (2008) discuss how gestures involving teacher-student physical contact, despite the complexities of touch, were perceived as important means for relating to and guiding students during physical education teaching, as well as for working with students who have special emotional and behavioural needs.

Another group of studies draws attention to external supports which aided teacher in-the-moment decision-making because they enabled teachers to view information about student progress on tasks. These studies focus on computer-based systems designed specifically to include the functionality of monitoring how students engaged with tasks. Shirley and Irving (2015) evaluate this functionality in a system of student handheld graphing calculators with a central teacher interface, highlighting how the information from the interface assisted instructional decision. Shirley and Irving, however, also stress that 'the teacher still had to process the data' and that the system 'did not tell the teacher what steps to take next in instruction or provide suggestions for modifying instruction for identified individual needs' (p. 65). Peng et al. (2009) point to a similar role in their study of a system connecting student handheld minicomputers and a central teacher interface displaying student learning portfolios. Gutierrez-Santos et al. (2012) also emphasise the potential for teacher decisions to be informed by digitally aggregated information about student activities and progress, focusing specifically on a computer-based mathematics task student interface which let teachers monitor student difficulties, misconceptions or lack of challenge.

Three studies focus on external supports that included suggestions for specific teacher actions and objectives (curriculum material and textbooks). These studies observe how such supports gave direction to teacher decisions, but also how decisions

involved adaptations that relied on other external supports. Choppin (2011) suggests that while written teacher resource material provided direction for instruction, the realisation of its objectives in practice also hinged on teachers' learned adaptations of its use. Alverman (1987) demonstrates how different subject teachers used textbooks material in different ways to refocus classroom discussions, using the textbooks to make adjustments to the discussion routines they had planned. Finally, Remillard (1999) notes that, regardless of their use of textbook material in lesson planning, the two teachers in the study relied minimally on textbooks in the enactment and adaptations in the classroom. Remillard instead shows how the teachers improvised the realisation of tasks by using student writing and answers to assess how they were progressing with tasks, and by giving verbal instructions, asking questions and providing resources like calculators.

Focusing in particular on moment-by-moment intricacies of accomplishing teacher-student interaction, five studies present external supports as means for teachers' continuous orchestration of student participation in tasks. Heritage and Heritage (2013) observe that teacher questions were key tools in guiding students beyond their reluctance to participate in interaction about content that was beyond their immediate abilities. Jordan and Santori (2015) show that teachers used talk to create different dialogical opportunities for student learning. Lorange and Erdogan (2009) finds that teachers' structuring of interaction around spreadsheet computer software requires continuous attention to the influence of students' expectations about spreadsheets. Korkiakangas and Rae (2013) parcel out one-on-one interaction between teachers and children with autism, demonstrating how the teacher used task-related material objects (for example puzzle pieces, a notebook or a worksheet) to capture, maintain and guide the attention of the child. In another study of one-on-one interaction, Waring and

Hruska (2011) analyse the unfolding interaction between a novice teacher and one first grade student, showing the ways in which the teacher relied on talk to elicit input from the student, offer choice, build compliance and counter opposition to participation in the interaction.

A final group of studies highlights the role of external supports in teachers' moment-by-moment guidance of and responsiveness to student understanding of subject matter content. They bring out different ways teachers used external supports as instructional devices to facilitate student understanding. Mortimer and Machado (2000) focus on teachers' use of talk and gestures for reconcilement of students' misunderstandings and confusion. Stieff et al. (2013) similarly examine the use of verbal explanations of chemistry concepts in teacher responsiveness to student understanding. Beauchamp et al. (2010) outline different ways in which teachers used interactive whiteboards to respond to students' engagement with tasks. McClain (2002) focuses on how teachers used digital interfaces to aid students' statistical reasoning, demonstrating how the teachers relied in particular on students' written and drawn inscriptions to guide understanding of subject matter content. Lastly, Mavers (2009) observes how teachers gradually aided the progression of student understanding by combining visual depictions, writing, gestures and talk in their demonstration of ideas and procedures.

2.3 Need for Theory Development

The literature search presented in the previous section covered a wide landscape of different research, locating relatively few studies that made conclusions about the role of external supports in teacher in-the-moment decision-making. The relative low

number of studies could be taken as evidence that external supports are unimportant for understanding teacher decision-making. The absence of attention to external supports in the broader decision-making literature might similarly be taken to suggest that external supports play a trivial role. However, despite the broader tendencies in the literature, the 19 studies that were identified in the literature search did provide vivid examples of ways in which the use of external supports was a crucial part of teachers' resolutions to challenging teaching situations. For the teachers who participated in those 19 studies, it seems plausible that their in-the-moment decision-making would have proceeded differently had they not been able to use the external supports that the studies brought to the fore.

As already mentioned, the variation between the 19 studies complicates drawing conclusions across them. Furthermore, as highlighted earlier, none of the studies set out to study the role of external supports directly. Inferences about the relationship between external support and decision-making were couched in discussions of other topics, for example curriculum implementation, student understanding of subject matter or behaviour management. The research designs were not set up to study the topic about external supports and the analyses and discussions mainly focused elsewhere. The studies also did *not* focus their conceptual work on defining concepts like in-the-moment decision-making and external supports. Nor did they conceptualise in detail the relationship between decision-making and external supports. The 19 studies instead discussed their findings in terms of specific teaching practices or issues.

The tendency across the studies to pursue very specific questions, however, also presented an advantage when it came to the reinterpretation of their findings. Because the studies focused on specific practices, challenges and techniques, they could be reread in relation to the more general topic about the role of external supports. The

reinterpretation of their findings undertaken in the review in relation to this topic hence moved beyond the specific functions that the articles ascribed to particular external supports. This required a systematic disentanglement and organisation of the relevant findings around the more general topic about the role of external supports, as outlined above. Grouping such specific functions, and cutting across different types of external supports, allowed the generation of themes on a conceptually more abstract level.

Looking across the 19 studies, it becomes apparent that the studies highlight external supports which are helpful tools for the conduct of teaching more generally, beyond moments where teachers need to make quick decisions. Textbooks, gestures, interactive whiteboards, talk and the rest of the external supports included in Table 3 above are common tools for teaching. The external supports that the studies reported on were not devices with particular utilities for making decisions. Although some of the above-mentioned technological devices that gathered data about students' progression on tasks could be seen as decision aids for the teachers, they were not designed for in-the-moment decision-making. Rather than embodying such narrow functionality, these technological devices provided information for the continuous assessment of students' activities, thereby being useful throughout many aspects of teaching.

As outlined above, the 19 studies pointed to different ways in which external supports gained particular significance during in-the-moment decision-making. Recapping the previous section, one theme was that the external supports were used as means for modifying student actions and behaviour. Another theme was their role as aids for assessing student progress on tasks. A third theme was their potential as sources of specific suggestions about how to teach. A fourth theme was the use of external supports as resources for adapting planned teaching objectives and procedures. Lastly, a

group of studies highlighted the role of external supports as devices for facilitating student understanding.

As outlined in Table 3 in the previous section, many of the reviewed studies focused on evaluating a specific group of external supports, for example examining only the use of either interactive whiteboards, textbooks or verbal questions. When looking across the 19 studies, however, the review suggests that an account of the role of external supports during in-the-moment teacher decision-making needs to capture many different types of external supports. This is highlighted by the many different types of external support that the studies found to be important.

A premature focus only on a specific group of external supports would cut off potential insights into interactions and combinations of different supports. Moreover, findings from some of the above-mentioned studies indeed indicate that teachers sometimes use combinations of different external supports to enact decisions. Mavers (2009), for example, highlighted the intertwinement in teachers' demonstrations of visual depictions, writing, gestures and talk. Another example is Remillard (1999) who pointed to the ways in which teachers' use of textbooks were supplemented through improvisation by relying on verbal questions and answers, calculators, student writing and student verbal answers.

Although the 19 studies were not designed to address directly the topic about teaches' reliance on external supports during in-the-moment decision-making, their pursuit of other research agendas led their authors towards conclusions relevant to this topic. The extensive literature search presented above, and the synthesis of the findings of the 19 identified studies, have shown a wide variety of examples that suggest that external supports can become important means for teachers' enactment of decisions during challenging moments of instruction. However, while these studies on a general

level agree to the significance of teachers' use of external supports, a fuller understanding of the topic requires a coherent conceptual framework through which it can be studied directly.

Despite their many examples of different ways in which teachers use external supports during in-the-moment decision-making, the insights drawn from the 19 studies remain highly anecdotal. When the full set of these piecemeal findings are considered together, however, they do indicate that there is potential for new insights, if research on teacher decision-making moves beyond its dominant focus on internal psychological processes. While the extensive literature search and review above provides an important first step, the pursuit of a better understanding of the external dimensions of teacher decision-making is still at a very early stage. Further enquiry needs to make the topic the direct object of study. It also needs to develop and rely on a coherent conceptual framework. Such a conceptual framework will provide better grounds for comparing and contrasting findings. It will also help explicate assumptions that can then be empirically evaluated. Lastly, a coherent theoretical framework will help make visible unexplored connections and stimulate the generation of new questions that can then be examined.

The next chapter presents the basic ideas behind the theoretical framework that is developed in this thesis. Following on from the observations made in this literature review, the theory development efforts presented in this thesis are a part of a deliberate attempt to depart from the main approach to the study of teacher decision-making, which has focused predominantly on internal psychological phenomena. The aim is to carve out a conceptual basis for systematic study of the ways in which teachers use external supports as means for enacting in-the-moment decisions. The theory

development undertaken in this thesis thereby seeks to unpack the dynamics alluded to in the 19 studies reviewed in this chapter.

Importantly, as will become clear in the next chapter, the development of a theoretical framework also guided this research project beyond issues raised in the literature. While the extensive literature search did turn out articles that include inferences about the role of external supports, these studies do not analyse or discuss the conditions for teachers' use of external supports. They do not address questions about whether external circumstances of decision-making situations have bearings on teachers' use of external supports and, thereby, on the decision-making itself. Such a line of enquiry, however, is at the heart of the research project presented in this thesis. It is formulated in research question two: *How do physical and cultural circumstances of teaching situations enable and constrain schoolteachers' use of external supports during in-the-moment decision-making?* As will become apparent in the next chapter, the attention to the situational shaping of teachers' use of external supports was motivated by building connections between theoretical ideas.

3 Theoretical Background

This chapter details how teachers' use of external supports was structured according to concepts drawn from cultural-historical research traditions, in particular the concept of artefact mediation. As highlighted in the previous chapter, the research literature on teacher decision-making does not offer well-established conceptual frameworks for examining the topic of this thesis. The strategy in this project to turn the research focus towards teachers' use of external supports during in-the-moment decision-making therefore required the development of a coherent theoretical framework. The development of such a framework was a core part of the aim of the research project, seeking to create the basis for systematic exploration of a new perspective on what in-the-moment teacher decision-making requires.

The project's focus on theory development means that this theory chapter occupies a particular role in the thesis. While it precedes the methods chapter, findings chapters and discussion chapter, the combination of ideas presented in this theory chapter is an outcome of continuous refinement of both concepts and analytical procedures in the data analysis. The methods chapter will detail the early iterations of the study and the analytical procedures that resulted, while the findings chapters will present the concepts proposed as answers to the research questions. The present chapter sets out the theoretical background and rationale that underpins the analytical procedures and the specific concepts developed in the findings chapters.

The theoretical basis for this research project was, from an early point, guided by three key ideas stemming from cultural-historical research traditions. The first idea is the notion that human actions are guided and achieved by means of artefacts that

mediate the person's interaction with the social and physical environment (Cole, 1996; Vygotsky, 1997; Wartofsky, 1979). The second idea relies on the notion of double stimulation (Sakharov, 1994; Valsiner, 2000; Vygotsky, 1987, 1999), portraying in-the-moment decision-making as a matter of drawing and acting on the environment in the attempt to fulfil or render obsolete challenging motive-orientations (Hedegaard, 2012a). The third idea is that the physical and cultural arrangements of any given situation have bearings on the use of artefacts within it, thereby shaping how actions are mediated (Daniels, 2012a; Hedegaard, 2012a, 2012b).

This chapter is structured according to these three key ideas: artefact mediation, double stimulation and situational shaping of artefact use. The first section presents the notion of artefact mediation, detailing general assumptions that guided the exploration of teachers' use of external supports. The next section discusses the definition of in-the-moment decision-making and basic assumptions about the functions of artefact use, thereby outlining the theoretical basis for the empirical exploration of research question one: *What role does schoolteachers' use of external supports play in their enactment of in-the-moment decision-making?* The third section details the theoretical underpinnings of the conjecture that physical and cultural arrangements of teacher decision-making situations shape artefact use. It thereby provides the conceptual background for research question two: *How do physical and cultural circumstances of teaching situations enable and constrain schoolteachers' use of external supports during in-the-moment decision-making?* The final section of the chapter summarises the theoretical assumptions into a basic conceptual model which underpinned the analysis of the data.

3.1 Artefact Mediation

Attention to the ways humans use artefacts is not unique to cultural-historical research traditions, nor to the concept of artefact mediation. The fundamental role of artefacts in human functioning has been highlighted as a key factor in the development of the human species, not only in philosophical investigations (Miettinen, 2006), but also in research on the use of tools among primates (Tomasello, Davis-Dasilva, Camak, & Bard, 1987) and by infants (Rakoczy, Tomasello, & Striano, 2005). Archaeologists have pointed to the influence of material objects on historical developments and their role in shaping of human engagement with their surroundings (Malafouris, 2013).

The attention to artefacts in cultural-historical research traditions has served as part of understanding the role of history and culture in day-to-day micro-level action and communication. Traditionally, such line of enquiry has been pursued in developmental psychology and educational research to understand children's development and learning (Hedegaard, 2002, 2012a; Mercer & Howe, 2012; Tharp & Gallimore, 1988; Valsiner, 2000; Vygotsky, 1997). Although research on children has been an important anchor point for the cultural-historical literature, the concept of artefact mediation has also, from the early research of Vygotsky and his colleagues, been used to study the everyday functioning of adults. Using the basic idea of artefact mediation, researchers have unpacked how different professionals accomplish their work by drawing on artefacts that, over time, have gained particular physical configurations and that have become imbued with certain collective meanings and personal sense (Engeström, Kajamaa, & Nummijoki, 2015; Hutchins, 1995).

In the present study, the concept of artefact mediation is adopted to explore how teachers accomplish their work, specifically during moments of decision-making, by

conceptualising the external supports they use as mediating artefacts. The broad interest in the notion of artefact mediation and the varied ways it has been applied in cultural-historical research requires explication of this study's theoretical positioning and definition of artefact mediation.

Due to this study's focus on the external dimension of teacher decision-making, on that which is 'outside the head', the definition of artefacts adopted here follows Cole (1996) and Wartofsky (1979) who stress that artefacts are observable material phenomena. However, while maintaining that artefacts are material, not any material entity is an artefact. Artefacts have histories in the sense that their physical configurations remind users of previous use of the same kind of artefact and the purposes for which it was made. To the extent that a person is familiar with an artefact, it brings with it particular meanings and utilities.

While the above-mentioned archaeologists (Malafouris, 2013) and researchers of human evolution (Rakoczy et al., 2005; Tomasello et al., 1987) focus their research on physical objects, the cultural-historical theoretical framework extends the tool-use idea to encompass also other material entities which can carry historically developed meaning through communication (Cole, 1996). A key area of study, for example, where the notion of artefact mediation has been influential, has been in research on talk which has emphasised the tool-like function of speech in learning and in social interaction (Mercer, 2008; Wertsch, 1991).

In this research project, artefacts include not only physical objects, nor are they restricted to spoken language. Instead, an inclusive definition of artefacts fits well with the aim of this study because it allows an integrative exploration of the range of different external supports that teachers use during in-the-moment decision-making. As pointed out in the literature review in the previous chapter, focusing on one type

obscures potential insights about cross-modal dynamics or interactions. Seeking an integrative perspective, this study follows Wartofsky (1979) and includes as artefacts physical objects, spoken language, written language, visual depictions, gestures and sounds.

The concept of mediation refers to the general role that artefacts can gain when they are made use of in human action and interaction. It points to an indirect relationship between the operation of an individual and the physical and cultural environment of that individual. It foregrounds how human engagement with, and transformation of, the external environment very often relies on artefacts as auxiliary means, rather than solely on corporal functions such as hands, nails, the legs etc. (Cole, 1996).

Artefacts have histories, with specific physical configurations and associated meanings, and they are useful for pursuing particular objectives. Employed to pursue particular ends, an artefact mediates action by *assisting* outward physical and social transformation of the environment because the individual employs the artefact's specific physical configuration and associated meaning (Cole, 1996; Wartofsky, 1979), for example by using the gesture of pointing to draw students' attention to text on a whiteboard. At the same time, an artefact mediates action by helping to *coordinate* operations of individual action (Hutchins, 1997). The individual draws on learned familiarity with artefacts to focus and complete actions, for example by relying on a PowerPoint slide to remind oneself of, and to formulate, the goal of a student task.

In this research project, artefact mediation does not refer to mediation of collective activities, as it is sometimes the case within cultural-historical research traditions, for example within branches of activity theory (Engeström, 1987, 2007).

Instead, in this research project, the focus is on the mediation of individual action: the actions of teachers in challenging teaching situations.

The concept of artefact mediation, as it is used in this study, is embedded in a specific understanding of what an action is. First of all, the notion of action stresses the intentionality of the actor. Following Leont'ev (1978), one of Vygotsky's contemporaries and colleagues, the defining feature of actions is that they are goal-oriented. From the perspective of the individual, actions are carried out with the purpose of achieving a particular goal within a specific situation. Furthermore, according to Leont'ev, actions are defined in terms of the operations undertaken by the individual within the objective environment of the specific situation. The operations are the *how* of the action, including the means that makes it possible and the conditions of the specific situation in which the action is carried out. As Leont'ev stresses, actions are both part of and contribute to collective activities. Specific actions therefore must be understood in relation to the collective activity of which they are part.

The emphasis on the relationship between artefacts and goal-oriented action in the concept of artefact mediation makes it particularly relevant for the purposes of this study. This study focuses on decision-making, situations where the individual teacher is lacking a sense of where to go next, and where the teacher settles the situation by choosing a course of action that is practically achievable within the given circumstances. Hence, a key component of the phenomenon is the settling on and pursuit of particular intentions. The inquiry into the role of external supports therefore focuses on the ways artefact use supports the realisation of teachers' intentions. The interplay between intentions and artefact use is also at the core of the notion of double stimulation, as will be detailed later in this chapter, after the following discussion of the reasons for drawing on the cultural-historical idea of artefact mediation.

Rationale for choosing the artefact mediation perspective

As highlighted in the introduction chapter, rather than separating internal and external processes, the concept of artefact mediation offers a way to understand how they are mutually dependent. The concept of artefact mediation thereby enables an exploration of the external dimension of in-the-moment decision-making which does not exclude internal phenomena. It offers a conceptual route which keeps open continuous engagement with the important insights about psychological processes which, as shown in the previous literature review chapter, have been the key focus in the research literature. Taking the perspective of individual teachers, stressing and accounting for the relationship between individual intentions and external supports, ties the role of the external to internal psychological phenomena.

Adopting the concept of artefact mediation brings a particular perspective to the study of teacher in-the-moment decision-making. It differentiates this study from other prominent theoretical traditions, which also offer rich resources for understanding external material aspects of human action. One alternative perspective, which could have been chosen as an alternative theoretical lens for the research project, lies in what is often referred to as science and technology studies (Latour, 1987) and actor-network theory (Law, 1992). Within this heterogeneous strand of research, researchers have turned their attention to the ways social phenomena and knowledge are constituted and reworked through networks and assemblages of external entities, things, inscriptions and human actors (Latour, 2005).

Part of actor-network theory's turn of analytical gaze involves a flattening of the hierarchy of human and non-human actors (Latour, 2005), stressing a bracketing of any priority given to the human or subjective. While this has been an influential methodological move, which has enabled fascinating analyses in many different

contexts, the lack of attention to the subjective dimension of individual action would be problematic in relation to the aim of this study. An exploration informed by actor-network theory of teacher decision-making would run the risk of replacing a one-sided focus on the internal with an account that deals only with the external. It would thereby cut off opportunities for dialogue with literature on psychological dimensions of decision-making. The strictly third-person point of view would furthermore analytically separate the use of external supports from intentions of their use, making it more difficult to make findings relevant to the work of teacher.

Taking the concept of artefact mediation as the theoretical starting point has the advantage of offering a level of analytical specificity that fits well with the object of study. The concept is suitable for the purposes of this study because it is general enough to capture teachers' use of different types of artefacts during a decision-making situation; and at the same time it points to a level of analysis that is specific enough to enable unpacking of the role of observable artefacts one-by-one, rather than grouping multiple artefacts or dealing with these in the abstract.

The concept of artefact mediation positions this study, in terms of object of study, between two poles for understanding situated action. The focus on artefacts, as well as the effects of their use, points to a level of analysis that is more concerned with individuals' contribution to collective activities than is typical of situated cognition perspectives. Situated cognition perspectives tend to focus on fine-grained analysis of the ways 'cognitive activity routinely exploits structure in the natural and social environment (the embedding thesis)' (Robbins & Aydede, 2009, p. 3), typically seeking to explicate the role of often very specific external structures in particular cognitive processes. While maintaining a more general analytical level than most situated cognition perspectives, the study's focus on artefact mediation allows enough

specificity to enable micro-level analysis of the functioning of individuals and their moment-by-moment use of external supports. It thereby also differentiates this study from situated learning perspectives (Lave & Wenger, 1991) or practice theories accounts (Schatzki, 2001) which both, despite their insistence on the importance the particularities of different situations, remain analytically at the level of the dynamics of collective practice, without discerning in detail the contribution of single individuals and their subjective perspectives, nor their specific use of external supports.

Finally, the concept of artefact mediation provides a promising outset for the exploration of teacher decision-making because the concept links closely with prominent frameworks for understanding teaching. Artefact mediation has, together with concepts like the zone of proximal development and scaffolding, formed the basis for a view of teaching, in which the teacher assists and extends the performance of students by offering artefacts which can mediate students' work on tasks (e.g. Gallimore & Tharp, 1990).

3.2 Artefact Mediation During Double Stimulation Situations

This section extends the theoretical basis presented above by specifying assumptions about the role of artefact mediation during in-the-moment decision-making. It details the conceptual framework through which the study approached research question one: *What role does schoolteachers' use of external supports play in their enactment of in-the-moment decision-making?* The framework consisted of two core concepts: the notion of double stimulation and the idea of motive-orientations, which will be described below.

Double stimulation

A strength of the concept of artefact mediation in relation to the purposes of this study is that it rests on the notion of double stimulation. The notion of double stimulation is particularly well suited for conceptualising the use of external supports during decision-making because it introduces a way to understand the relationship between artefacts and requirements of challenging situations. The notion of double stimulation specifies assumptions about how artefact mediation operates during attempts to resolve challenging tasks. It is therefore particularly well-suited for guiding the exploration of research question one, which concerns the role of teachers' use of external supports during in-the-moment decision-making.

The notion of double stimulation concerns situations in which individuals confront requirements that they do not initially have the capabilities to satisfy (Engeström, 2007). The notion of double stimulation specifies the dynamic through which an individual makes use of the environment in attempts to satisfy problematic requirements. Within double stimulation terminology, the requirements that the individual is initially not able to meet are referred to as the *first stimulus*. The *second stimulus* refers to the elements of the external environment that the individual draws on and employs to satisfy the first stimulus. In the double stimulation situation, the element from the external environment (second stimulus) becomes an instrument that mediates the attempt to deal with the problematic requirements (first stimulus).

Beyond providing a conceptualisation of artefact use in challenging situations, an important advantage that comes with the notion of double stimulation is that it rests on a method for studying artefact mediation (Sakharov, 1994; Vygotsky, 1987, 1999). Conceptualising teachers' use of external supports in terms of the notion of double stimulation therefore opens up rich methodological resources, which have been

developed within cultural-historical research traditions. The reliance on the notion of double stimulation, both as a theoretical concept about the nature of the object of study and as a methodological principle for studying the object of study, was an important part of achieving congruence between the theoretical framework and the methodological principles.

As will be described in further detail in the methods chapter, a core part of this research project was the adaption of the method of double stimulation for analysis of teachers' *in situ* use of artefacts during challenging teaching situations. Initially, the notion of double stimulation was used by Vygotsky and his colleagues for experimental studies (Sakharov, 1994; Vygotsky, 1987, 1999). An experimenter would present research participants with a challenging task and make certain artefacts available to the participants. The studies conducted by Vygotsky and his colleagues were set up in such a way that the requirements of the situation (the first stimulus) was kept stable throughout the experiment (Vygotsky, 1987). Keeping the task stable, the experimenter could then manipulate the second stimulus by making certain artefacts available to the research participant. This allowed the researchers to observe how the artefacts were taken up, appropriated and used by research participants.

In a study without experimental manipulation, identification of the requirements of the situation (the first stimulus) has to rely on a robust analytical framework. As will be detailed in the methods chapter, this research project sought to analyse in-the-moment teacher decision-making as it unfolded in classrooms. Without experimental control over the researched situations, and because of the focus specifically on in-the-moment decision-making, the requirements of the challenging situation (the first stimulus) had to be carefully conceptualised. This was done by drawing on the concept of motive-orientations.

Motive-orientations

The challenging requirements that teachers were facing and seeking to satisfy during in-the-moment decision-making (the first stimulus of the double stimulation situation) were conceptualised through the concept of motive-orientations. The concept of motive-orientations has been developed within the cultural-historical research tradition (Hedegaard, 2012a). The idea of motives and conflict of motives has previously received attention from researchers adopting the method of double stimulation (Hopwood & Gottschalk, 2017; Sannino, 2015; Sannino & Laitinen, 2015). The concept of motive-orientations, as used in this study, is drawn from Hedegaard's (2009, 2012a, 2012b, 2014) research on motivation within educational institutions.

According to Hedegaard (2009, 2012a, 2012b, 2014), motive-orientations are referring to intentions that are pursued by an individual in a specific action within a specific situation, but which go beyond that action and situation, and which relates to the traditions of the institutional practice in which the situation is embedded. The concept relies on the idea that individuals are guided by objectives that span multiple actions and situations. Following Hedegaard's theory of motivation, the requirements facing an individual in a specific situation are seen as intersections between institutional objectives, demands from knowledge traditions, demands from others present in the situation and orientations towards personal motives. Motive-orientations are those general demands or motives a person seeks to satisfy by setting and pursuing specific goals in specific situations.

The concept of motive-orientation is consistent with the goal-directed understanding of action described above. It, however, extends the conceptualisation of double stimulation situations by moving the analytical gaze beyond immediate goals of a single action and beyond the immediate situation. It draws attention to the ways

specific goals organise according to more general objectives that individuals pursue through sequences of specific actions and across different situations. It helps enable interpretation, for example, of the way in which the goal of showing students a particular Spanish sentence is part of a motive-orientation of helping students understand certain grammatical features.

The ways the concept of motive-orientations guided interpretation of the data will be detailed further in the methods chapter. The methods chapter will also highlight how the concept of motive-orientations was pivotal in identifying instances of in-the-moment decision-making and the requirements that teachers were experiencing and dealing with in those situations. The concept of motive-orientations helped define more precisely what constituted in-the-moment decision-making. Instances of in-the-moment decision-making were seen as those situations where teachers did not immediately have a course of action that could satisfy their motive-orientations, but where the teachers nevertheless, by means of their external environment, found ways to satisfy them or make them obsolete.

The concept of motive-orientations was also in helpful in specifying how the *moment* of decision-making is understood in this research project. As stressed in the introduction, this thesis examines decision-making that teachers engage in when unanticipated challenges arise during a lesson and the phrase 'in-the-moment' is used to highlight that the need for decision-making emerges as part of the unfolding of the teaching. The onset of the decision-making moment is understood as the point in time where the teacher first experiences challenges in pursuing one or more of his or her motive-orientations. The moment of decision-making ends when the teacher's course of action has satisfied or made obsolete the motive-orientation, either by orchestrating a change in the teaching activity that caters to the problematic motive-orientation or by

changing the activity in such a way that the motive-orientation is no longer relevant. This broad definition of the moment of the decision-making is useful because it allows for the inclusion of a diverse range of teaching challenges, as will become apparent in the findings chapters. Furthermore, the definition helps avoid an unwarranted separation between the individual's identification of a course of action and the individual's enactment of that course of action. Choosing and enacting a course of action are *not* seen as occurring at two different time points; instead both aspects are seen as intertwined in the action-by-action unfolding of the in-the-moment decision-making.

3.3 Situational Shaping of Artefact Use

This section builds on and extends the conceptualisation developed above by focusing on the context of artefact use. It explicates the theoretical underpinnings for the exploration of research question two: *How do physical and cultural circumstances of teaching situations enable and constrain schoolteachers' use of external supports during in-the-moment decision-making?* This research question was motivated in particular by a general idea from the cultural-historical tradition about the relationship between artefact mediation and situations of artefact use. The idea is that the physical and cultural arrangements of any given situation have bearings on the use of artefacts within it, thereby shaping how actions are mediated by artefacts (Daniels, 2012a). This section details the conceptual basis for examining the situational shaping of artefact use by considering how 'context' was understood and by highlighting the concept of activity settings.

Context as interweaving

The concept of artefact mediation and the way it is explicated through the notion of double stimulation place considerable emphasis on the physical and cultural environment in which an individual participates. The notion of double stimulation draws attention to ways individuals make aspects of the environment part of their flow of action and the ways they attempt to change the environment with those actions. Furthermore, as Cole (1996, p. 144) summarises, 'artifacts and systems of artifacts exist as such only in relation to "something else" variously referred to as a situation, context, activity, and so on.' In other words, both the meaning and the utility of artefact use are constituted by the context of their use.

Studying artefact mediation without attention to the context of artefact use would run counter to core assumptions about their interdependency. When studying artefact mediation, as Cole (1996, p. 132) points out, seeing context 'as that which surrounds' does not capture the mutual constitution of artefact use and the situation of artefact use. Cole instead suggests the metaphor of interweaving as a way to capture the continuous unification artefacts and situation through action. The metaphor of interweaving is suitable because it portrays artefact use as a bringing-together of different circumstances, which gives the artefacts a place and a role in the creation of the overall pattern of the unfolding activity.

This study's attention to the role of teaching situations, which is specified in research question two, is a natural extension of the theoretical exploration of the role of artefact mediation during in-the-moment decision-making. It is underpinned by the interdependence of action and external environment expressed in the notion of double stimulation. It was guided by the following general rationale about the possible role of physical and cultural circumstances: if artefact use is important to individual decision-

making, and if individual decision-making takes place within activity settings that have specific physical and cultural configurations, then it becomes relevant to examine whether, and in what ways, artefact use is shaped by specific configurations of activity settings.

Activity settings

Hedegaard's (2012a, 2012b) concept of activity setting provides a way to foreground the configurations of teaching situations. It thereby provides an entry point into the exploration of the situational shaping of artefact use during in-the-moment teacher decision-making. The concept of activity settings highlights that specific situations are arranged in particular ways, physically and culturally, and that these arrangements have developed over time and in relation to cultural traditions of the institutional practice in which they are embedded, in this case a school. The concept is drawn from Hedegaard's overall theory of motivation and it therefore links directly to the concept of motive-orientations, which was described above. The concept of activity settings helps explicate how individuals pursue motive-orientations across different immediate situations and how such pursuits require constant negotiation with the physical and cultural arrangements.

The concept of activity settings was helpful in foregrounding ways in which in-the-moment teacher decision-making was taking place within settings that were imbued with different collective meanings and physical configurations. The concept helped highlight that, prior to the teachers' decision-making, settings had developed over time into particular arrangements, which had bearings on the activities that took place within them. The concept helped relate the moment-by-moment micro-level analysis of interaction to physical and cultural arrangements that had developed over time, opening

up the question about how those arrangements provided conditions for artefact use during in-the-moment teacher decisions.

As will be apparent in the methods chapter and findings chapters, the arrangements of activity settings were *not* examined through a historical analysis of the cultural and institutional origins of the arrangements of activity settings. Instead, this study examined the situational shaping of artefact use from the other end, analysing the moment-by-moment dynamics between established activity setting arrangements and artefact use.

Rather than a final conceptualisation, the concept of activity settings provided a broad analytical entry point into the exploration of the situational shaping of artefact mediation. While the concept of activity setting is a general one, the aim of the analysis in this study was to interpret and conceptualise the specific physical and cultural circumstances that became important conditions for the teachers' actions during in-the-moment decision-making. Together with the other concepts described above, the notion of activity settings informed the general theoretical framework that underpinned the data analysis. This general framework is summarised below in a basic conceptual model that outlines the key theoretical assumptions.

3.4 Basic Conceptual Model

The notion of double stimulation draws the analytical attention towards the uptake of external, physical artefacts in individual higher mental functioning. The focus is on the "processes of mastering our own reactions" (Vygotsky, 1997, p. 207). The approach draws attention to the mutual shaping of the individual and his or her environment (Daniels, 2010). The object of study, when following this approach, is a dynamic in

which the individual contributes to and transforms his or her environment while at the same time being shaped by this engagement with the environment.

As Leont'ev (1997, p. 19) notes, Vygotsky's work enabled the study of mental processes as a 'nonclosed system which was open to the outside world.' This idea is central to the concept of artefact mediation; and it becomes particularly central in the method of double stimulation. In the method of double stimulation, the study of the role of the environment in individual functioning is opened up by identifying or manipulating task requirements and artefact availability. In this way, the method of double stimulation is set up for the study of the coming together of personal mental functioning and aspects the observable environment.

Although the terminology of 'stimulus' is used (e.g. Vygotsky, 1987, p. 127), neither the problematic task (the first stimulus) nor the artefacts (the second stimulus) should be considered as variables that produce automatic reactions from the individual[1]. The first and the second stimulus are *not* assumed to influence the decisions of the research participant in any unidirectional way. Instead, in line with the concept of artefact mediation, the first and the second stimulus are assumed to become part of the system that produces the decision. Despite the prominent role of the word 'stimulus' in its name, the method of double stimulation is designed for the study "moments where a person arrives at a *dialectical synthesis*" (Valsiner, 2000, p. 7, emphasis in original), where requirement of the situation and artefacts are brought together in actions. The approach enables the study of how motive-orientations and artefacts become part of the whole that is the person's decision-making. Because of this part-whole dialectic, the separation between the person's subjective experience and the role of the external

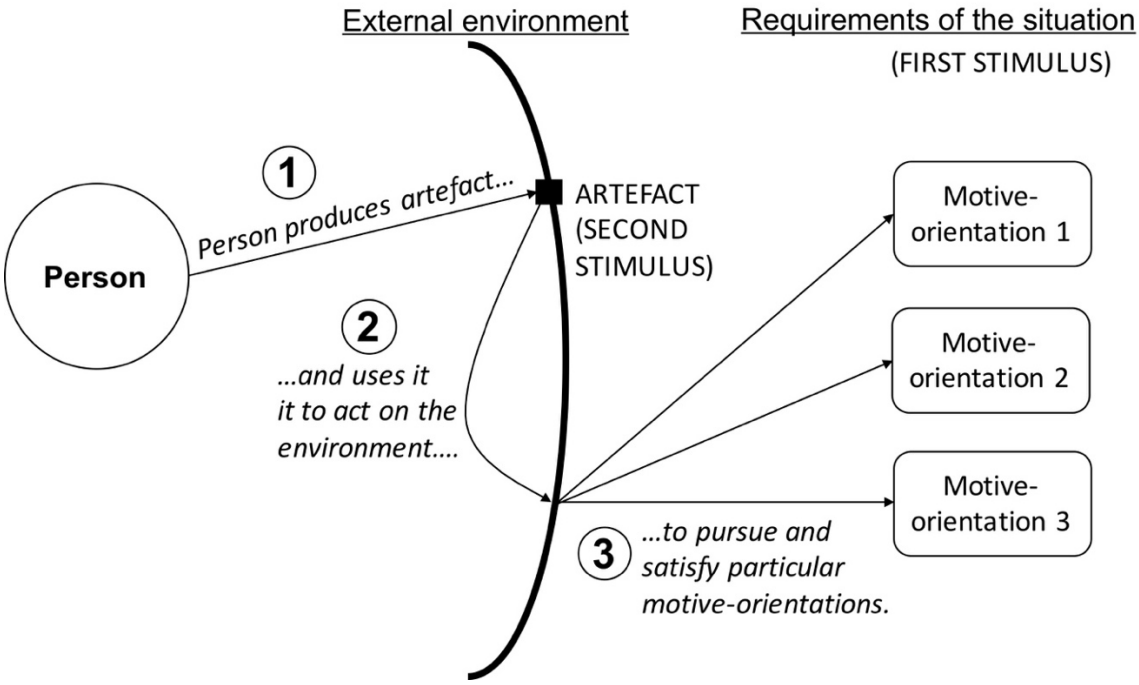
[1] Acknowledgements to Mariane Hedegaard for raising this point during personal communication after a presentation on this research project at the Nordic ISCAR 2016 conference. See also Sannino's (2015, p. 4) discussion of the use of the word 'variable' in the context of the method of double stimulation.

environment relied on an analytical separation (Sawyer, 2002), not an ontological one.

In this study, the notion of double stimulation had clear implications for the exploration of the role of external supports in teacher in-the-moment decision-making. As Valsiner (2000) notes, double stimulation situations involve individuals arriving both at goals for action and means for actions. As stressed above, the notion of double stimulation draws attention to the coming together of intentions, on the one hand, and artefact use on the other. It highlights aspects of in-the-moment teacher decisions that lie beyond distanced contemplations about what to do. It stresses that dealing with the problematic requirements of a situation requires active production and use of artefacts that assist and help coordinate actions. The notion of double stimulation foregrounds that pursuing a goal involves seeking out artefacts that will enable actions relevant to that goal.

As Valsiner (2000) stresses, the notion of double stimulation assumes that individuals have an active role in the production of artefacts. Valsiner points out that the individual produces the artefact by manipulating the external environment, producing instruments or means for goal-directed action. Inspired by Valsiner's detailing of the individual's active role in the production of artefacts, and building directly on his visual model of the double stimulation situation (Valsiner, 2000, p. 79), Figure 1 below outlines a model of the basic assumptions behind the present study's analysis of in-the-moment teacher decision-making. In accordance with the whole-part dialectic mentioned above, the different components in Figure 1 should be seen as making up a unit, where the different components are mutually constituting. The unit that Figure 1 analytically unpacks outlines conceptual relations pertaining to one action of a teacher during in-the-moment decision-making, focusing on the role of the use of external supports and the role of physical and cultural circumstances.

Figure 1: Basic Model of Artefact Use During In-the-Moment Decision-Making



Relying on the notion of double stimulation and incorporating the concept of motive-orientations, Figure 1 outlines schematically the assumptions which guided this study's analysis of teachers' use of external supports. The assumptions are numbered in Figure 1 above and can be outlined as follows: the teacher (1.) manipulates the external environment to produce artefacts, (2.) using these with the goal to change the external environment in particular ways, (3.) motivated by expectations that the changes to the external environment will contribute towards satisfying the requirements that the teacher recognises in the situation. As outlined in Figure 1, and in line with the discussion earlier in this chapter, the requirements responded to by the teacher (the second stimulus) are seen as motive-orientations that the teacher seeks to satisfy.

The following example illustrates the assumptions of the model: a Spanish language teacher (1.) writes a Spanish sentence on a whiteboard (producing an artefact), (2.) leaving this sentence on the board for the students see (intended change of

environment) (3.) as part of pursuing the overall objective to explain a certain grammatical feature that the students were struggling to understand (seeking to satisfy requirements that the Spanish teacher sees as important in the specific situation).

While the basic model in Figure 1 above summarises the basic assumptions that guided the analysis of the role of external supports in teachers' in-the-moment decision-making, the assumptions it outlines, however, remain at a general level. Furthermore, the assumptions are not specific to the conduct of teaching. The basic model allowed an entry point for the data analysis. As will be described in the subsequent chapters, it opened up a way to analyse instances of teacher decision-making in detail and it provided a coherent basis for the theory development efforts relating to the two research questions. Guided by the basic model in Figure 1, the further conceptualisation undertaken in the findings chapters focuses on explicating the specific dynamics that were at play during the teachers' in-the-moment decision-making. Addressing research question one, chapter six focuses on the function the teachers' use of artefacts in satisfying challenging motive-orientations. Addressing research question two, chapter seven examines the role of the external environment in the production and communication of artefact.

As already mentioned, arriving at the assumptions and combinations of ideas presented in this chapter was an outcome of iterations of data analysis, readings of the theoretical literature and refinements of initial ideas. A brief overview of the early iterations of the study is provided in the beginning of the next chapter, which also describes in detail the research design and analytical procedures that resulted from the early iterations. The next chapter describes how the method of double stimulation was adapted for the purposes of this research project, and it details how instances of teacher

decision-making were analysed action-by-action to identify the motive-orientations that the teachers were pursuing and the artefacts they relied on to do so.

4 Methods

The introduction chapter included an example of the mathematics teacher Richard's in-the-moment teacher decision-making, in which he diverted from his initial plan when he realised that the students were struggling to understand how to work out a list of questions. As detailed in the example in the introduction, Richard responded by quickly developing an explanation of key concepts on the whiteboard. In doing so, he relied on a range of external supports, including verbal questions, instructions, explanations, the gestures of students' raised hands, a drawn jelly-fish-like illustration, writing and students' verbal answers. The present methods chapter presents the research design and analytical procedures that allowed this study to get at the external supports used by teachers like Richard during in-the-moment decision-making.

The approach to data collection and data analysis was developed in accordance with the basic concepts presented in the previous chapter. Following the theoretical framework outlined in the previous chapter, external supports were understood as mediating artefacts assisting teachers in dealing with challenging teaching situations. The in-the-moment decision-making situations were interpreted as double stimulation situations where the teachers sought out artefacts with which they could change challenging teaching situations and thereby satisfy motive-orientations that had become problematic for them.

Before describing the details of the data analysis approach, this chapter starts by accounting for the basic methodological principles that were developed in the earliest iterations of the study. The chapter then provides the rationale for the case study design

and the data collection process. The goal of this chapter is to make transparent the background for the findings presented in the remainder of the thesis.

4.1 Principles From Early Iterations

As described in the introduction, the earliest phase of the study was guided by an interest in collaborative continuing professional development. Following the logic of professional development initiatives, the initial focus was on activities where support for teachers' work was assumed to happen, rather than the activities where the support was needed and potentially put to use. This meant that early visits to the school focused on their weekly Friday morning professional development sessions, which introduced participants to specific techniques they could apply in their teaching. These meetings provided excellent opportunities for getting to know the teachers and the school. They did *not*, however, provide any detailed information about the support teachers were actually using in their classrooms.

On the basis of early pilot study phase, and as mentioned in the introduction chapter, the focus was shifted from the professional development meetings onto the classroom interaction itself in order to study the role of external supports in teachers' resolutions to challenging situations and the conditions of their use. However, the move from the staffroom to the classroom was only the first step. The questions about teachers' use of external supports in the classroom required a systematic approach for data collection and analysis.

The approach, which was developed in this study and which is detailed in this chapter, relied on two main principles. First, inspired by micro-process studies of teaching, the study zooms in on moments of teacher decision-making. Second, it adapts

the method of double stimulation to identify teachers' use of external supports. These two principles are described below.

Zooming in on challenging teaching incidents

Systematic attention to teachers' resolutions to challenging situations was aided by a principle drawn from micro-process studies of teachers' work. Micro-process studies of teachers' work are designed to identify patterns in teachers' moment-to-moment interactions and to analyse these patterns in relation to the work environment in which the interaction takes place (Little, 2012). The key analytic strategy, which was drawn from micro-process studies and taken up in this research project, is the idea of studying teachers' work by moving between 'zooming in' and 'zooming out'. 'Zooming in' involves an analysis of micro-level (moment-to-moment) interaction 'for a deeper understanding of the practices and perspectives in play in specific moments (events, activities)' (Little, 2012, p. 160). 'Zooming out' involves analysing how micro-level interactions 'reside in a larger landscape of work practice' (p. 160) and how patterns of interaction relate to general features of the workplace.

The micro-process approach to the study of teachers' work has been adopted for the study of professional learning (Horn, 2005, 2010; Horn & Kane, 2015; Horn & Little, 2010; Little, 2002; Little & Horn, 2007), teachers' concepts about work (Hall & Horn, 2012), teachers' concepts about students (Horn, 2007), teachers' use of data (Horn, Kane, & Wilson, 2015; Little, 2012) and teacher problem-solving (Horn, 2013). Researchers using the micro-process approach have tended to study discussions among teachers, unpacking dynamics of teacher talk outside classrooms. For the purpose of the present study, however, the principles of zooming in on micro-level interaction informed the analysis of classroom teacher-student interaction.

A key feature of the micro-process approach has been to focus the analysis on problems of practice. The term problems of practice describe problems that arise in the classroom and which are then taken up and discussed in subsequent teacher-teacher discussions (Horn & Little, 2010). The strategy of zooming in on challenging teaching incidents fitted the purpose of the present study because it focused the study of moment-by-moment unfolding of situations where teachers make in-the-moment decisions. Instead of centring the analysis on teacher talk, however, this study focused on unpacking the teaching incidents themselves through analysis of classroom observations. The details of the analytical procedures of zooming in are the topic of the latter part of this chapter. As will become clear in the later descriptions of the analytical procedures, the systematic approach whereby challenging teaching incidents were understood and analysed rested on adaptations of principles from the method of double stimulation.

Adapting the method of double stimulation

In the previous chapter, the idea of double stimulation was presented as a key component of the basic theoretical model that guided this study's investigation of teachers' use of external supports during in-the-moment decision-making. As the previous chapter also highlighted, the theoretical notion of double stimulation is closely linked to a matching methodological principle. This relationship offers coherence between theory and method. Originally, however, the methodological principle was used experimentally by Vygotsky and his colleagues (Sakharov, 1994; Vygotsky, 1987, 1999), as described in the theory chapter. An experimental setting put research participants in a situation where they struggled to solve a task. The setting was manipulated in such a way that participants had available certain potentially useful

artefacts. This allowed researchers to study whether and how participants made use of the available artefacts to engage with the challenging task.

In the present study, the goal was to study in-the-moment teacher decision-making as it unfolds in the natural setting of the classroom. The double stimulation approach therefore had to be adapted for the study of challenging teaching incidents as they play out *in situ*. While the original use of the principal of double stimulation followed experimental designs, it has since been used extensively outside experimental settings. It has been used in intervention studies, including in studies of schools. Furthermore, and in line with the approach of the present study, the methodological principle has been utilised in the study of everyday situations without researcher intervention, relying instead on detailed observation data.

In the intervention studies, the focus has been on explicating first stimulus (problematic tasks) and second stimuli (mediational artefacts) as part of developing and studying organisational processes. Following Engeström's (2007) formative intervention design, often referred to as Developmental Work Research (DWR) (and sometime also 'Change Laboratories'), a number studies has used the method of double stimulation for the study of how professionals can collaboratively overcome problems at work (Engeström, 2001; Nuttall, Thomas, & Henderson, 2016; Sannino, 2011). Following Engeström's approach, the focus has been on analysing the effects of introducing professionals to particular artefacts, often including a visual model that outline conceptual relationships between different aspects of the professionals' work (Engeström, 2001, 2007).

Another group of researchers have also used the method of double stimulation for intervention studies into workplaces by adopting the DWR framework. However, in these studies, mediating artefacts were studied by analysing the conceptual resources the

professionals brought up and employed in their attempts to solve a shared problem (Daniels et al., 2007; Edwards & Daniels, 2012). Yet other groups of researchers used the DWR interventions to study specifically the unfolding of conflicts between professionals' different motives (Barma, Lacasse, & Massé-Morneau, 2015; Engeström & Sannino, 2011; Sannino, 2008, 2010).

Several studies have used invention-based double stimulation approaches specifically for the study of teaching activities in schools. Early applications of the DWR approach were conducted in schools (Engeström, Engeström, & Suntio, 2002; Sannino, Engeström, & Lemos, 2016). Following the DWR framework, Ellis and colleagues have argued for the value of the method of double stimulation in promoting and enabling the study of initial teacher education (Ellis, 2008), teacher professional creativity (Ellis, 2011), and teachers' continuing professional development (Ellis, Gower, Frederick, & Childs, 2015). The method of double stimulation has also been used in intervention studies which followed an alternative route than the DWR approach. These exceptions have focused on the study of computer-supported collaborative learning in schools, introducing and analysing computer-based tasks and resources into classrooms, conceptualising these as first stimulus and second stimulus (Krange & Ludvigsen, 2008; Lund & Rasmussen, 2008).

Recently, the method of double stimulation has been adapted specifically for the study of everyday situations with no researcher intervention (Engeström et al., 2015; Hopwood & Gottschalk, 2017; Thompson, 2013; Waermö, 2016). In these studies, neither the first stimulus (challenging requirements of the situation) or second stimulus (mediational artefacts) were intentionally configured by the researchers. Instead, first and second stimuli was analysed on the basis of rich observational data. As Sannino (2015, p. 2) points out, Vygotsky did include such analyses in his writing, when

illustrating the double stimulation principle through examples of everyday behaviour. However, the empirical work conducted by Vygotsky and his colleagues remained committed to the experimental setup (Sakharov, 1994; Vygotsky, 1987).

The recent observation-based adaptions of the method of double stimulation (Engeström et al., 2015; Hopwood & Gottschalk, 2017; Thompson, 2013; Waermö, 2016) share four general characteristics. These four characteristics are also central to the design of the study presented in this thesis. The first characteristic is the focus on processes *in situ*, with *no researcher intervention*, *no experimental control* of the situation, and *no comparisons with control cases*. The second characteristic is the reliance on *observations* as the main source of data, replacing the focus on transcripts of professionals' discussions that was central in the DWR intervention studies mentioned above.

The third characteristic is the need for identifying *challenging incidents* in the data. Rather than intentionally inducing double stimulation situations, the researcher has to wait until problematic situations arise. These challenging incidents, i.e. the double stimulation situations, thus need to be identified through subsequent data analysis. The researcher does not control the situation, and does not control the first stimulus (problematic task) nor the second stimulus (availability of artefacts). The resulting fourth characteristic is that also *first and second stimulus have to be identified through analysis of the data*, which requires that inferences can be made about research participants' challenging motive-orientations and their use of mediating artefacts.

Together with his colleagues, Engeström, who originally adapted the method of double stimulation for intervention study through the DWR framework, proposed and demonstrated the use of the method for the study of 'critical encounters' as they unfold in the everyday work of home care workers (Engeström et al., 2015). The move away

from researcher intervention and into the analysis of the unfolding of professionals' everyday work was accompanied by a shift in focus and type of data. Instead of relying on transcript of researcher-directed meetings, Engeström et al.'s study used observation data (videotaped) of short sequences of critical incidents where care workers and elderly clients negotiated conflicts of motives. In Engeström et al.'s study, those conflicts of motives were seen as the first stimulus. Analysing the moment-by-moment unfolding of the critical encounters, the analysis proceeded through an identification and classification of the mediating artefacts (second stimuli) that the care workers made use of.

Hopwood and Gottschalk (2017) made an adaption of the method of double stimulation similar to the one used by Engeström et al. (2015). Hopwood and Gottschalk relied on written observations, analysing challenging incidents of work place interaction between professionals and clients which involved conflicts of motives. Thompson (2013) studied in situ unfolding of teaching activities in classrooms, drawing on the method of double stimulation for the analysis of observation data (videotaped), and focusing on students and their use of mediating artefacts. Also focusing on students rather than teachers, Waermö (2016) used the principles of the method of double stimulation to analyse observations of primary school children's break time play.

In the original experimental approach, research participants were taken out of their natural environment into a controlled setting. Adapting the experimental method of double stimulation for in situ analysis has the advantage of allowing for investigation of the object of study, teacher decision-making, as it unfolds within the setting of interest, in this case, their usual classroom. An intervention study design resembling those often used in the DWR approach did not match the kind of decisions this study sought to investigate. The use of the intervention study adaption of the method of double

stimulation has focused on the study of systemic organisation-level changes, introducing the double stimulation intervention as an extraordinary part of research participants' everyday settings in order to facilitate both new challenges and new solutions.

The in situ adaption of the method of double stimulation is appropriate for the purposes of this research project because it focuses on challenges teachers experience in their everyday work and the way they make in-the-moment decisions to resolve such situations. Compared to the experimental and intervention approaches, the in situ approach is well suited for the study of challenges that would occur also without researcher presence. As will be discussed later in this chapter, the researcher will inevitably influence those situations and the participation of the researcher should be made part of the analysis. However, when paying attention to the role of the researcher, the in situ approach provides a way to study challenging situations as they are experienced and resolved by teachers in their everyday work.

The option of experimentally controlling some aspects of classroom settings would have been premature, if it had indeed been possible. The reason is that the topic of teachers' reliance on external supports during decision-making has received very little systematic attention in the research literature. Without a basic initial understanding of the role of external supports in teacher decision-making, it would be very difficult to choose appropriate interventions to make, and it would be hard to adequately interpret results from such studies. Similarly, high-N designs such as self-report questionnaires would run the risk of being structured according to unfounded assumptions about the object of study. Because of the limited previous research in this area, a detailed analysis of a low number of in situ cases was an appropriate first step in opening up this topic.

4.2 Case Study Design

The decision to conduct a case study was guided by the aim to develop theory in an area of study that has previously received relatively little systematic attention. As noted above, the absence of well-established theories and methods presented a danger of prematurely delimiting which data would be relevant. Flexibility was needed in order to develop and adjust conceptualisations and analytical procedures throughout the study.

Intervention designs or self-report designs, such as diary studies or cross-sectional questionnaires, would have required pre-established categories and hypothesis about the topic at the outset of the study. Because of the limited research into this specific area, however, such categories and hypotheses would have risked becoming highly speculative and they would have led to an unfounded reduction of what should become the focus of the study. Adopting such approaches without pursuing a more holistic understanding of the in situ unfolding of in-the-moment decision-making would not have afforded possibilities for staying open to insights arising from the research field, and it would have been prone to generating partial accounts without a coherent framework for interpreting the results.

The case design fitted the aim to study in-the-moment teacher decision-making as it plays out in the classroom because it allows a focus on the object of study *in situ*. The case study design made it possible to continuously develop theory and methods through iterations of data collection and data analysis. In this way, the study was designed to prepare the grounds for future research, which places higher demands on researchers to pre-specify conceptualisations, hypotheses and operationalisations, for example studies following intervention-, experimental- or self-report designs. Chapter nine includes a discussion of the ways in which future research can draw on this study's

development of a holistic and coherent theoretical understanding of the real-time unfolding of in-the-moment teacher decision-making.

This research project adopts an *embedded* case study design (Yin, 2014). The embedded design consists of three levels: the school, the teachers and the instances of in-the-moment decision-making. The school is the setting and the context for the cases. The teachers are the cases. Following the above-mentioned principles of zooming in on double stimulation situations, instances of in-the-moment teacher decision-making are the key units of analysis focused on within each case. The latter part of this chapter on data analysis describes in detail the way the analysis zoomed in to investigate the case teachers' use of external supports during in-the-moment decision-making.

This study has a relatively small number of cases, five teachers all from within the same setting. The goal to have variety between cases was the guiding principle for choosing which teachers to follow. The five case teachers were selected to allow for contrast between subjects taught, levels of teaching experience and gender. The five case teachers are:

1. Brian, a newly qualified history teacher
2. Emma, a newly qualified English teacher
3. Michael, an experienced science teacher
4. Isabel, an experienced Spanish teacher
5. Richard, an experienced mathematics teacher

Having only one setting, an English secondary school, allowed for richer background data than would have been the case if the same number of visits had been made across different schools. For this reason, comparison between different schools was not attempted in this study, although such comparative work is a possible area for future research. As highlighted in the final chapter, it is hoped that future comparative

work will be able to build on the theoretical and methodological work undertaken in this in-depth analysis of a single school.

The choice of school for this exemplar study was guided by a focus on assuring that it was a school where the staff were generally happy to work in. As will be detailed in the next chapter about the case teachers and the school context, it was a school that the staff perceived to be doing well, rather than a struggling school. The rationale for this 'positive' focus was part of this project's attempt to show that being unsure about the course of action is a common and important part of schoolteachers' work, also when the work is going well. The 'positive' focus was also motivated by an ethical concern about the way the study portrays the work of schoolteachers. The topic of in-the-moment decision-making could bring out undesired negative perceptions of the participating teachers and risk discrediting the work of schoolteachers, if the many examples of resolutions to challenging teaching situations were read as a sign of the teachers' inability to do their job. Focusing on a school that was doing well was part of insisting that the need for in-the-moment decisions will inevitably arise.

The choice of school was based on several visits and different sources of data. These included five interviews in March 2015 with the school's principal, assistant principal and three teachers. It also relied on the results of an extensive survey in which the school and its teachers participated. Both the survey and the interviews were conducted as part of a different research project that I was working on as a research assistant and which was led by my supervisors, Ian Thompson and Harry Daniels. The decision was also based on two visits to the school in July 2015 where I conducted interviews with teachers and participated in staff meetings. I discussed my research project with the principal, assistant principal and teachers to ensure mutual interest and to align expectations about the study. On this basis, I found that the school was well

suited for the study and that the school was very interested in supporting my research. This was subsequently confirmed in the data collection process.

The rationale for this low-N strategy was, as already mentioned, to enable in-depth analysis by allowing for extensive data collection about each case. In-depth analysis of rich data was necessary because the goal was to develop theory. The rationale for the low-N strategy followed the logic of *analytic generalisation* rather than statistical generalisation (Yin, 2014). Generalisation is not, in this project, based on an assertion that the cases were drawn from a certain population of cases to which findings can then be generalised. Instead, generalisation from this study is conceptual. It depends on future analyses of new cases and the extent to which the concepts, categories and theoretical propositions developed in this study are found to be appropriate and adequate for the analysis of those new cases. Future studies of in-the-moment teacher decision-making may, at a later point, come to rely on statistical generalisation and include high numbers of cases in order to test pre-specified hypotheses. However, the present study investigates a relatively low number of cases to enable in-depth analysis with the goal to develop theory.

A holistic focus on each of the case teachers was important in order to capture the teachers' perspectives on their in-the-moment decision-making. An in-depth understanding of each case teacher was needed because the study aimed to capture the teachers' intentions, along with identification of the artefacts they used. It was essential because of the aim to span both psychological and practical dimensions and it aligned with the emphasis in the theoretical framework on the interplay between artefact use and individual motive-orientations. Moreover, a detailed understanding of each case teacher was crucial to the validity of the analyses of their in-the-moment decision-making.

Examples of decision-making were unpacked action-by-action, using the method of double stimulation to identify the case teachers' motive-orientations and artefact use. Multiple examples for each case teacher were interpreted in relation to background descriptions of the teachers. The design thereby took advantage both of the holistic understanding of each teacher and the micro-level analysis of specific examples. It thus enabled the generation of rich case descriptions of each of the case teachers' use of external supports and the practical requirements it involved.

Through in-depth analysis of the five cases, this study sought to develop theory by using the data to challenge and refine the initial theoretical propositions. Theory elaboration is not merely about using the data as inspiration for the formulation of new models and concepts. As Vaughan (1992, p. 175) stresses, theory elaboration in case study research is 'the process of refining a theory, model, or concept in order to specify more carefully the circumstances in which it does or does not offer potential for explanation.' Theory elaboration requires constant attention to the danger of confirming unwarranted claims and it needs the researcher to ensure that evidence is systematically evaluated to avoid selective and glossing over key data (Yin, 2014). Adapting the method of double stimulation for the purposes of the present studies enabled the development of rigorous procedures for analysing the data.

The detailed analysis of the case teachers, the procedures of which are presented in the latter part of this chapter, was done in order to challenge and refine the theoretical framework, continuously evaluating its adequacy and relevance for noticing and understanding individual teachers' use of external supports during in-the-moment decision-making. Keeping with the theory development strategy of the research project, concepts were developed and evaluated throughout the analysis of the cases. The overall analytical strategy was to specify concepts that allowed a detailed, coherent and relevant

description of case teachers' use of external supports and the conditions that enabled and constrained their support use. Hence, concepts and categories were continuously evaluated by considering the descriptions they enabled. The evaluation relied on differences in support use, both within cases and between cases. The rationale was that the emerging concepts and categories should account well, and with no exceptions, for similarities and dimensions of differences without compromising the level of detail of the case descriptions. In other words, if concepts or categories were not descriptive of all five cases, they would be replaced or refined.

The project addresses its two research questions by presenting and discussing the conceptualisation that was developed and refined in the data analysis. Thereby, the study offers concepts that help in understanding teachers' use of external supports during in-the-moment decision-making (research question one) and the practical requirements of support use (research question two). Apart from being important results in their own right, the case descriptions allow evaluation of the conceptual claims. Furthermore, they provide detailed exemplification of the developed conceptualisation, which is essential for assessing its adequacy and relevance for understanding of future cases (Yin, 2014). The presentation of the findings in chapter six and seven therefore alternates between, on the one hand, the detailing of the developed concepts and, on the other, the case descriptions that were enabled by the concepts.

4.3 Data Collection

In the following, the data collection process is presented. First, an overview of the data is given. Then, a discussion is provided of my role as a researcher in the research site and my influence on the data. The ethical considerations that were incorporated into the

conduct of this study are also presented. Lastly, the three main sources of data are described: interaction-based observations, interviews and documents. To make the study's data transparent, the sections below include examples of data excerpts and detailed accounts of how the data was collected.

Overview of the data

The data was collected over approximately 40 visits to the school over the course of the school year 2015/2016. Table 4 below outlines the data that were collected and specifies the number of observations and post-lesson interviews conducted with each of the teachers. Table 4 also includes details about what activities were observed and about interviews with school management. Finally, it lists the different kinds of documents that were collected.

Table 4: Overview of the Data Collected and Used in the Study

Case teachers	Observations	Post-lesson interviews
1. Brian, history teacher	4	4
2. Emma, English teacher	3	3
3. Michael, science teacher	3	3
4. Isabel, Spanish teacher	4	3
5. Richard, mathematics teacher	3	3
Total:	**17**	**16**

Observations of teacher-led Friday morning professional development meetings:
15 observations of 20-minutes weekly morning meetings in the main staffroom, collected between September 2015 and March 2016.

Other observations:
Observations of two professional development days for the school's teaching staff, September 2015.

Other interviews:
One interview with the principal conducted as part of my supervisors' research project, March 2015.
One interview with the assistant head conducted as part of my supervisors' research project, March 2015.
One interview with the assistant head discussing findings from my research project, July 2016.

Documents:

Documents about the school:
- News stories about the school in national and local online newspapers
- Local authority documents describing policies and initiatives
- Reports about the school (e.g. from the inspection body Ofsted)

Documents produced in the school:
- School web site October 2015 and August 2016, including school policies available on the school's web site
- Minutes from school leadership team meetings available on the school's web site
- The school social media profile page (Facebook)
- Newsletters from the school
- Job advertisement posted by the school
- Internal teaching and learning newsletter sent weekly to all teaching staff
- Teaching staff's professional development handbook
- Staff planner stating school-related events
- Invitations to, and documents from, staff professional development events
- School's development plans

Documents used by the case teachers:
- Documents used in the Friday morning professional development meetings
- PowerPoint presentation slides
- Lesson plans
- Handouts given to students in lessons

My role as a researcher

Before moving on to the details about each type of data (the observations, interviews and documents), two general points about my role as a researcher in collecting this data require attention. The first point concerns the way I conceptualise *my influence on the data* and the second has to do with the extent to which I had *access to the everyday work* of the case teachers.

My influence on the data is in this research project conceptualised as analytical opportunities rather than something that needed to be eliminated. The interactions resulting from my presence were written down in observations or they were included in the interview transcripts. They are part of the data and those interactions were analysed alongside other interactions captured in the data. Following the approach of Hedegaard (2008a), I see myself as a participant in the situations I researched and thereby as someone who also contributed to those situations. My question about an upcoming lesson could, for example, potentially become a chance for that teacher to formulate the goal of a lesson before subsequently describing it to the students. My contributions to the researched situations were not, however, structured in a certain way so as to systematically intervene. Instead, my contributions to the researched situations were subjected to analysis by focusing on the ways the case teachers responded to what I did or said.

I gained access to the everyday work of the case teachers by becoming a familiar face in the school through my presence at Friday morning staff meetings and by being presented to all of the staff by the school principal on a professional development day at the beginning of the school year. The teachers' Friday morning meetings were used as opportunities to introduce individual teachers to my project and to ask them whether they would be interested in participating in my research. Although the teaching staff

knew that I was a university researcher, I found it easy to fit into the flow of the school day. The visitor's badge around my neck clearly indicated that I did not work there. However, the school received a large number of visitors and it was common for teachers or members of the management team to show guests around the school. Furthermore, several teaching staff had English as a second language, making my Danish accent sound less strange. Hence, although it was clear to everyone that I was a researcher, it was easy for me to sit down at meetings or walk around the school without attracting unnecessary attention.

The teachers were very open to being observed. All the teachers I asked invited me come and observe their work and took the time to do the post-lesson interviews. Over the course of the year, it became clear that teachers were frequently observed and that they often had others in the room while teaching. The principal would, for example, come in with visitors for 2-5 minutes during a lesson, or student teachers on placement in the school would be there observing. The professional development program in the school had peer-observation as a key component and other teachers would often come in to collect books or to ask something during lessons. The students seemed very used to someone being in the room and to being observed, and seemed to pay surprisingly little attention to my presence in the classrooms. Several times I asked case teachers about the students' reactions to my presence. Every time the case teachers would give a similar reply along the lines of: "The students are very used to people coming in to observe."

As argued above, I did contribute to the researched situations and these contributions yielded important analytical opportunities. The access I had in the school and the way my presence was received, however, did allow me to observe, interview and collect documents without changing the situations altogether. It allowed me to

collect data on the everyday work and in-the-moment decision-making of the case teachers without obstructing the flow of their activities.

Ethical considerations

Ethical approval was obtained from the Departmental Research Ethics Committee (DREC). The ethical approval letter and CUREC application are included in the appendices on p. 296. Two ethical considerations that go beyond those already described in the CUREC application in the appendices are presented below.

First, I often interact with colleagues and others that know the school. For this reason, I have had to consider what information I give about the school throughout the research process, in presentations and in my everyday interaction with colleagues and friends. For instance, naming an initiative that the school had started could enable individuals that know the school well to identify it. Beyond using pseudonyms for teachers and students, not disclosing to colleagues which school I was studying was essential in order to keep the anonymity of the school and my research participants.

The second issue had to do with the power relations within the school, namely between the case teachers and the school management. The school management team was interested in hearing about some of the information I had gathered and the thoughts and conclusions I drew from it. Throughout the data collection process, I had to make sure that any statements that I conveyed to the management team (or anyone else) would not reflect badly on my participants. It was possible also to address this issue by formulating and expressing my reflections in ways that ensured that they would not be attributed to any particular individual or group of individuals, thereby protecting my research participants.

Observations

Observations were conducted following Hedegaard's (2008a, 2008b) procedures for interaction-based observation. This type of observation focuses on the actions of particular individuals (the case teachers): the actions they initiate, their interactions with others and any conflicts that they encounter in those interactions. Actions initiated by others (e.g. a student using a mobile phone) and features of the room (e.g. the arrangement of tables) were noted down with the goal of understanding what the teachers responded to and the ways they responded to it, as well as what they did not respond to. This type of interaction-based observation allows for interpretation of the goals individuals try to achieve and the means they use to achieve these goals.

The observations relied on extensive written notes made during school visits, including verbatim quotes and details about the interactions between those being observed, the room, the objects used and my interactions and conversations with staff. For most of the classroom observations, notes were written while sitting in the back of the classroom with a laptop. At staff meetings, and whenever the use of a laptop would have been obtrusive, notes were written by hand in a notebook. One hour of observation of either staff meetings or lessons would, for example, produce between 12-16 pages of handwritten notes that in turn would produce 8-10 computer written pages. A one-hour lesson would produce approximately 1500 words of computer-written notes which would subsequently be written up in approximately 3000-4000 words. Data excerpt 1 below illustrates the type of observations conducted in this research project and it gives a sense of the level of detail captured in these written observations. Data excerpt 1 shows a section of a written-up observation. The appendices, on p. 306, include the notes written in the classroom during the same five minutes, making it possible to compare the observation excerpt below with the classroom notes.

Data excerpt 1: Excerpt from written-up observation (5 minutes of one of Richard's lesson).

> 'Richard writes and talks, doing a calculation involving sine. Richard says in a loud voice: Divide your sins! (as part of the calculation where each side of the equation is divided by sine). Richard says: That is what they told me when I went to [name of a school Richard went to]. A student says (sounding surprised): Were you at [name of the school Richard went to]?
>
> Richard writes on the calculation and says (referring again to the calculation): I can get rid of my sins, I am forgiven! (Richard puts his arms out to the sides and smiles as he says this).
>
> Richard is calculating through the question/calculation. There are 4-5 steps downwards, drawn on the board, next to the triangles that are projected to the left-hand side of the whiteboard.
>
> Richard: What does it come up with? (Richard asks about a calculation; I think sine of some number). The student says: Error. Richard: Error (seemingly expecting this). Richard: Have you all got error (Richard looking around the classroom).
>
> Richard: As a little side note, you don't have to all write this down. Richard is writing out a calculation on the right-hand side board, explaining how a part of the calculation/formula could be transformed into 1^-sin. Richard writes out the steps in a box that he draws around this transformation. Richard: Just do

> 10^-1 on your calculator, prove that it is one tenth (i.e. exemplifying one step of the transformation).
>
> Richard says: "Do that on your calculator, to show you can do it. Make sure that your calculators are all in degrees mode. Your calculators must be in degrees mode."
>
> Richard: Then have a look at question four (this question is in the book and Richard is referring to the top of the left-hand side of the board where he has written three lines with different tasks for the students to do).
>
> Richard: And in order to motivate you, I am going to put on some motivational music. A student in the back comments (not loud - rather saying it to those sitting next to her and in front of her): It makes me wanna cry. A boy in front of her turns around, smiles and says: "You are so negative today."'
>
> (Richard, observation)

Although the writing up of the observations was a time-consuming task, the notes written in the classroom (see the example in appendix 11.3 on p. 306) made it easy to write out the observations. The observations were written up mostly within 48 hours, although with some exceptions with observations written up within one week. A clear procedure was adopted to counter problems of lack of memory and avoid distorting the information in the written observations: if I had any difficulty in remembering something, it would either be omitted entirely from the written observation or clearly indicated in the written observation. Furthermore, double quotation marks were used to indicate when direct quotes had been noted down,

whereas no quotation marks were used when there was a chance that speech had been paraphrased.

Three main factors aided the achievement of a high level of detail in the observations. First, the public nature of the teachers' work, characterised by endeavours to communicate clearly with the students, made their use of artefacts more easily accessible to observation. Second, the data collection procedures of focusing observations specifically on the teachers ensured elaborate accounts of the unfolding of their actions. Third, a high level of detail in the observations was ensured by making elaborate notes, which were then carefully written out shortly after the observation. The match between the analytical procedures and the granularity of the observation data was evaluated in the early iterations of the studies, in which preliminary analysis was undertaken to check the data was sufficient and whether it matched the strategy.

Compared to the option of using video recording, written observations provided a good balance between breadth of data and level of detail of the data. Observations allowed the inclusion of more lessons and of activities in staffrooms and at break time. Furthermore, within lessons, the angle of the camera and the sound quality of the recording would have cut out information that it was possible to attend to when writing the observations. It was also anticipated that, if video had been used, attention to the recording process would have hindered the collection of important data, which was gathered by interacting with the case teachers through casually asking questions before and after lessons. Moreover, it was anticipated that videoing would obstruct the flow of the lesson, whereas having visitors observe lessons was common practice in the school. It was also likely that use of video recordings would have limited the teachers' willingness to participate in the study.

Interviews

Three types of interviews were conducted in this research project: post-lesson interviews with the case teachers, recorded interviews with school management and casual questioning during observations. Each are described in turn below.

The post-lesson interviews were the main source of interview data. The post-lesson interviews were conducted during breaks between teachers' lessons or after the final lesson of the day. The 15-25 minute interviews were audio recorded and transcribed. The interviews always used a lesson that I had observed immediately prior to the interview as a fix-point for interview questions. The goal was to anchor participants' accounts in concrete examples, to make sure that topics were fresh in memory and to get a high level of detail in their descriptions. Furthermore, focusing the interview on a lesson I had observed helped ensure that the teachers' accounts were relevant to any examples of in-the-moment decision-making later identified in that lesson.

The interview technique that was used relied on Brinkmann and Kvale's (2015) approach to research interviewing. The semi-structured layout of the interviews allowed time for probing questions, clarification and validation of my understanding of the interviewee's accounts. It also allowed enough flexibility to ask teachers about topics they themselves brought up during my visits. Interview questions were kept open to allow the teachers to pick up and talk about the aspects of the lesson they found relevant. The interviews followed interview schedules written down prior to the visits to the school. Although there was some variation between the interview schedules and my questions across different visits and teachers, they largely covered the same themes: the lesson generally, planning the lesson, surprises, choices, challenges and support. Sometimes, I would add a question about a specific aspect of the lesson that I observed

or about something the teacher had brought up before or during the lesson. In designing the progression of the questions, the goal was to start with the most open questions, before asking more focused questions. Figure 2 below shows a typical interview schedule to illustrate the kinds of questions used.[2]

Figure 2: Example of a Typical Post-Lesson Interview Schedule

1. From your perspective, how would you describe the lesson in period 2?
2. Can you talk me through your planning of that lesson?
3. Was there any part of the lesson that turned out differently than you initially anticipated?
4. Were there any things you debated between before or during the lesson?
5. What were some of the challenges of teaching this lesson?
6. What were the steps you took in order to meet these challenges?
7. What challenges did you avoid?
8. If you could somehow magically change anything around this lesson, any constraining conditions, what would you change?
9. Are there anything that we did not touch upon?

The recorded interviews with school management were background data in this study. Like the documents collected, they provide information about what was important in the school and about the activities that took place there. The interviews

[2] Interview schedules used in interviews were hand-written in my notebook. This example has been typed up here to make it easy to read.

focused on professional development activities in the school and collaboration between staff. The two interviews with the principal and the assistant head in March 2015 (see Table 4's overview of the data above) were conducted by myself and a colleague as part of my supervisors' research project on teachers' collaboration patterns. The semi-structured interview schedules were thus designed according to that focus. These 30-40 minute interviews, however, also contained information relevant to understanding the school in which the case teachers were working. To provide further information about the school context, I also recorded my meeting with the assistant head in July 2016 in which I fed back and discussed preliminary findings from my project (see Table 4). This interview was hence much less structured and took place more as a conversation about my project and about professional development in the school.

Asking casual questions during observations provided a rich source of information. Although these interactions were not audio recorded, I had plenty of opportunities to write down in my observation notes what teachers and members of the school management team had told me. For instance, before observing a lesson with a case teacher, I would often ask the case teacher about what they were focusing on in this lesson. Such casual questioning would take place in the school corridors on the way to a classroom, in the classroom while the teacher was making the room ready, or in staff rooms. Often, the teachers would also themselves bring up topics about their upcoming teaching or a lesson they had just taught. I would also note down the interaction between staff in which teachers would ask each other questions, discuss or describe past or upcoming situations or lessons. To illustrate the kind of information that the casual questioning provided, Data excerpt 2 below contains my written observation notes on my interaction with the maths teacher Richard after one of his lessons.

Data excerpt 2: Example from observation of casual questioning after one of Richard's lessons.

> 'I talk to Richard about the music. I ask Richard whether there was anything about why Bach (the composer) was good for doing maths. Richard says that it is just something that he has read and that he did not go into detail reading it. Richard about this Bach-fact: "Still waiting for the day a student comes and contradicts me." Richard says that he would like that. Richard says about the Bach fact: It was something that I read when we were training. Richard: Personally, when I do maths, I listen to punk rock. Richard: They need to sit in silence in the exam. Richard: But it is good when they are learning something new.' (Richard, observation)

Documents

Three categories of documents were collected: (1) documents about the school, (2) documents produced in the school and (3) documents used by or referred to by the key teachers. Table 4's overview above of the collected data outlines the documents that were collected within each category. The documents were collected to supplement the observations and interviews, especially with a view to understand the school as a context for the case teachers' work. The documents provided data on the local, societal and historical context of the school. The documents included context information that aided the interpretation of the observations and the interviews, supporting the 'reading' of what was going on within specific situations (for example by knowing from a school

newsletter about an event that a teacher would mention to the students in an observed lesson).

In this study, documents were *not* regarded as unproblematic windows into events and the state of affairs in the school. Instead, a documentary analysis approach was adopted in which the focus was on meaning structures and institutional logics of action (Ventresca & Mohr, 2005). The starting point for the documentary analysis was hence attention to the creator of the document, its intended audience and the contexts of its production. Consideration of these aspects made documents valuable sources for understanding interpretations, agendas and assumptions in the school. The documents were used in order to get an overview of the demands that the teachers faced when working in that school, allowing insights into what was valued in the school and what was demanded of the teaching staff.

4.4 Data Analysis

The analytical procedures presented in this section operationalise the two methodological principles described in the beginning of this chapter. The data analysis procedures described here enabled a zooming in on challenging teaching incidents that the five case teachers experienced during observations, and the analysis adapted the method of double stimulation to unpack those incidents. The analytical procedures were developed specifically for the identification of the external supports teachers rely on during in-the-moment decision-making, providing a basis from which to interpret the role of their use of external supports (research question 1) and the conditions for their support use (research question 2). The following presentation of the analytical procedures details, first, how instances of in-the-moment decision-making were

identified in the data and, second, how the use of external supports was unpacked action-by-action through an elaborate analytical table.

Locating instances of in-the-moment decision-making

The first step in the data analysis was to identify instances of in-the-moment teacher decision-making. The identification of instances of decision-making involved flagging up potential instances and organising the relevant data excerpts around those potential instances. It also involved subsequent examination of each potential instance in order to determine whether they were actually examples of in-the-moment decision-making. The identification of instances therefore proceeded by first asking: where are the potential instances in-the-moment decision-making? It then moved on to examine the question: are they really instances of in-the-moment decision-making?

The procedures for identifying potential instances were based on an operationalisation of this research project's definition of in-the-moment teacher decision-making. As described in the introduction, and as detailed in the theory chapter, this project defines in-the-moment teacher decision-making as any situation where teachers are unsure about how to proceed with an aspect of their teaching, and where they nevertheless, in that same teaching session, find a course of action that resolves the problem. In screening for potential instances, the data (observations and interviews) were read carefully for any of the following indications of in-the-moment decision-making:

1. Aspects of a particular lesson *reported by the teacher as uncertain or challenging*, either verbalised by the teacher retrospectively about a lesson or through verbalisation while teaching a lesson.

2. Indications that the teacher was *hesitating or pausing* during a lesson.
3. Instances in a lesson where the teacher *diverted from his or her plan or course of action*.

In many cases, several potential instances of decision-making were flagged up within the same lesson. If two potential instances were similar, these were still kept separate and the instances were merged only later in the analytical process, if they were found to make up one and the same instance. This cautious approach was adopted to avoid premature inferences about the potential instances.

The procedures for identifying potential instances of decision-making were defined prior to the screening of the data and hence acted as guidelines for the analysis. Those procedures are presented below. The qualitative data analysis software NVivo was used to navigate the data and to organise data excerpts. Three computer monitors aided the navigation of the data, making it easy to move between the original data sources, collections of data excerpts, notes and guidelines for how to proceed in the analysis.

Classroom observations and post-lesson interviews were read through, taking one case teacher at a time. When finding passages in the data that indicated that a teacher engaged in in-the-moment decision-making, a 'node' was created, named and linked to that data excerpt (a node is a feature in the qualitative analysis software NVivo that allows the user to create and name a virtual 'container' into which sections of data can be drawn or assigned). Upon finding indications of a potential instance, the classroom observations and post-lesson interviews were reread to add any sections of the data relevant to the created node. The data was reread multiple times and other observations (beyond the observation of the specific lesson) and documentary data were

consulted to ensure that all relevant elements in the data were included.

Throughout the data analysis process, the whole body of data was repeatedly consulted and any background data found to be relevant to a particular instance of in-the-moment decision-making was added to that node's collection of data excerpts. Proceeding in this way, data excerpts were organised around nodes that each formed collections of data relevant to potential instances of decision-making. The data were thus ordered in collections of excerpts from observations, interviews and documents, and the reading of the data was thereby purposefully and systematically focused on the object of inquiry (Maitlis & Lawrence, 2007; Middleton, 2010): on instances of in-the-moment decision-making.

To illustrate how the data were organised around potential instances of in-the-moment decision-making and to give examples of potential instances, Table 5 below outlines the 15 instances identified through screening the three observations and the three corresponding post-lesson interviews conducted with the science teacher Michael. Table 5 outlines the names that were given to each of the nodes as they were formed in the screening process, with each node containing a collection of data excerpts that were found to be relevant to a potential instance of decision-making.

Table 5: Potential Instances of In-the-Moment Decision-Making Identified Through Screening the Observations and Post-Lesson Interviews Conducted with the Science Teacher Michael

1. Am I doing something wrong that causes the students to misbehave?
2. There are some things that I cannot teach the students, that the students must learn themselves
3. Trying different things to create silence and focus among students
4. Maybe unsure about how far to take the joke

5. Finding ideas for activities for the lesson
6. How to do the start-of-the-lesson activity
7. Sitting quietly, going over a test, is "not the nicest bit of learning"
8. Not knowing what to do, while students are working quietly (getting bored)
9. How to ensure that all of the students do all of their homework
10. Not sure whether he has taught them this before
11. Needs to gather thoughts before the lesson
12. Diverts from his plan of having students read out their prepared scripts
13. Running out of activities and having extra time at the end of the lesson
14. Balancing time-use between "fun questions" and "time to improve"
15. What to do about an "irritating" question that gives students points even for wrong calculations

It is important to stress that the 15 nodes outlined in Table 5 were *potential* instances. Further analysis allowed for consideration of borderline instances through a detailed rereading of the data, for example scrutinising the above-mentioned potential instance named '4. Maybe unsure about how far to take the joke'. As described above, the screening of the data for potential instances was only the first step. It needed to be followed by an examination of each node to determine whether they were indeed instances of decision-making. The procedures for that examination are presented below.

Examination of each potential instance proceeded by shifting the mode of analysis from including anything that could potentially be relevant towards seeking to exclude instances. While the initial screening sought to include all potential instances and relevant excerpts, the subsequent examination of each potential instance involved being sceptical about whether the teacher engaged in decision-making during the

identified incidents. This involved asking questions about the instance such as: was there a point where the teacher was unsure about what to do?

The fine-grained reading and questioning of each potential instance was guided by the operationalisation of in-the-moment decision-making that was presented above and which was also used in the screening process. Hence, arguments for including an instance were based on the following: (1) the extent to which the teacher reported aspects of a lesson to be uncertain or challenging; (2) the extent to which the teacher hesitated or paused during their teaching; and (3) the extent to which the teacher diverted from his or her plan or course of action.

Box 1 below illustrates the procedure by providing an argument for the inclusion of the instance '1. Am I doing something wrong that causes the students to misbehave?' from Table 5 above. The same instance that is used as an the example in Box 1 will also be used later in this chapter to illustrate further the analytical procedures. This particular example is about student behaviour, but it could just as well have been decision-making about a different challenge, considering the breadth of different challenges which is evident from Table 5 and which will also become apparent in the findings chapters.

Box 1: A written-out argument for the inclusion of the instance 'Am I doing something wrong that causes the students to misbehave?'

Less than five minutes into Michael's year 7 physics lesson 12:10 pm on a Friday, he makes the first comment about the students' behaviour:

> 'Michael says that he is going to wait – looking around the classroom (i.e. going to wait until there is less noise). Some students are talking or calling/shouting out. At least five times there are noises, banging on tables, students

> talking out loud. Michael says: Don't make noises.' (Michael, observation)

Michael is not, at this point, unsure about what to do. However, subsequently challenges arise as his attempts to correct the students' behaviour only briefly quiet the students. Michael becomes uncertain about how to stop the students from disrupting the progression of the lesson. This instance of in-the-moment decision-making becomes visible in Michael's verbalised retrospective accounts about the lesson. It is also visible at points where Michael diverts from his course of action. The main clue that Michael was indeed unsettled about which course of action to take comes from a short conversation between Michael and a teaching assistant who is also in classroom. Referring to the students' behaviour, Michael asks the teaching assistant: "It is not just me, is it?" Michael's question indicates that he was concerned about the students' behaviour and his management of the students' behaviour. Furthermore, Michael diverts from his course of action at least three times during the beginning of the lesson. These three points support the inference made from Michael's question to the teaching assistant. Michael's diversions indicate that his concern about his behaviour management was not only a post-hoc evaluation. The first point of diversion is mentioned above, where Michael says he is going to wait until there is less noise, diverting from his questioning about the slide and about the topic of the lesson. A similar interposition is made by Michael a few minutes later where he diverts from a series of questions about how different plants disperse seeds:

> 'Michael asks how they do (i.e. how the plants do with the seeds). One student yells out: You eat them! Michael says: And stop (as in stop talking/shouting answers). Michael "We will not accept our learning and our progression of the lesson to be slowed down by (...)" (i.e. ...noise/interruptions/students talking).' (Michael, observation)

Michael resumes asking about seeds. He gets an answer from a student and then asks a student to come sit somewhere else. Michael asks more questions about

how plants have adapted and he gets several answers by picking students with hands up. At this point, Michael takes a longer diversion from his questioning and explaining about plants and seeds. Michael sends two students out:

> 'A boy makes sounds. Michael says something about the noise. Michael says: Sorry there is about four of you (...). Michael says that two boys need to leave the classroom. Michael: [Name of boy], you. The boy says: Sir, you didn't give me a final reminder, and you give me detention. A boy sitting next to him says: It was me. The boy that has been given detention says four times: It wasn't me! The boy says out in a loud voice (sounding very displeased): "Why are you always picking on me! You are sending me out!" Michael: Clearly not, I am sending you out without a final reminder, but I am sending you out. The boy gets his stuff and walks towards the door, still saying things about it being unfair. The other boy that was also sent out, who said "it was me", already stands in the front of the classroom door with his jacket on.' (Michael, observation)

The points of diversion described above support the inference that Michael was, at least momentarily, unclear about which course of action to take. While these diversions and Michael's choices about what to do happen very fast, the post-lesson interview provide further support that these actions were challenging. Michael described the lesson as "hectic, as in their behaviour wasn't great coming in, and then throughout it was just hard work consistently." He also said about this lesson that the "challenge is to get them through the instructions so they can actually start enjoying the activity in which we lost a couple of people to excluding them for poor behaviour." He furthermore said: "The challenge was to capture their imagination in the first place. Which I thought I failed."

The examination of the potential instances made it possible to determine which instances to subject to further analysis. As Box 1 above illustrates, it was indeed possible to decide which instances from the initial screening that qualified as instances of in-the-moment decision-making. The precise delimitation of the start and end of each of the instances of in-the-moment decision-making was not, however, determined through the procedures described above. It was determined through the subsequent analysis of each of the included instances, which is presented in the next section. Those procedures involved a closer zooming in on each of the included instances and an action-by-action analysis of each instance. Those procedures thereby provided even firmer grounds for interpreting whether teachers indeed engaged in decision-making. Furthermore, it was through the subsequent action-by-action analysis of each included instance that the method of double stimulation was employed to identify the teachers' reliance of external supports.

Identifying teachers' use of external supports

The next main part of the data analysis, after having located instances of decision-making, was to identify and describe the external supports the teachers made use of during those instances. The interpretation proceeded by means of an analytical table that structured the analysis of the action-by-action unfolding of each instance of decision-making. The analytical table, and the analytical procedures it guided, were based on the principle of *double stimulation* and it drew on the concepts that were discussed in the theory chapter as ways of understanding the first and the second stimulus of a double stimulation situation. These two main concepts were *motive-orientations* and *mediating artefact*. Recapping what was detailed in the theory chapter, these concepts are presented briefly below.

Motive-orientations are a category of intentional content that is pursued by an individual in a specific action within a specific situation, but that goes beyond that action and situation. The concept, which was developed on the basis of the work of Hedegaard (2012a, 2012b), rests on the idea that individuals pursue objectives that span multiple actions and situations. Motive-orientations are objectives a person seeks to satisfy by setting and following specific goals in specific situations. Attention to the motive-orientations of teachers allowed for analysis of their in-the-moment decision-making. It made it possible to specify the challenging demands faced by and responded to by the teachers during the instance of decision-making. Furthermore, the concept of motive-orientations provided a way to systematically describe the purposes for which external supports were used as mediating artefacts by the teachers to enact decisions.

Mediating artefacts are the external supports teachers made use of during instances of in-the-moment decision-making. The concept is based on the idea that human action is guided and achieved by means of artefacts and that a person's interaction with his or her environment is, in that sense, mediated by those artefacts (Cole, 1996; Wartofsky, 1979). Artefacts, in the definition used here, are understood broadly and the category does not only include physical objects, but also spoken language, written language, visual depictions, gestures and sounds.

Systematic attention to the relation between general motive-orientations and mediating artefacts was the guiding principle for the identification of the external supports made use of by the teachers. This analytical approach was developed by adapting the basic principle of the *double stimulation method*. As previously described, the double stimulation method was originally designed to study the interplay between intentional orientations and artefact use (e.g. Sakharov, 1994; Vygotsky, 1987). The method was originally used in experimental settings where an experimenter presented

research participants with a challenging task and certain artefacts to solve the task. The challenging task, involving requirements that the individual is not initially able to solve, was referred to as the first stimulus. The available artefacts were referred to as the second stimulus, being the elements of the environment that the individual turns to and employs in attempts to satisfy the demands of the challenging task (Engeström, 2007).

In this research project, the first stimulus and second stimulus were not experimentally controlled. Instead, the goal was to examine what the first stimulus and the second stimulus were through analysis of the data. In this analysis, the first stimulus was analysed as the motive-orientations that the teachers were finding challenging to satisfy. The second stimulus was analysed as the mediating artefacts that the teachers used to enact the resolutions that satisfied or made obsolete the challenging motive-orientations. Using the general idea from the original double stimulation method, the analysis of instances of decision-making thus proceeded by identifying the motive-orientations that made up the challenging task and identifying the mediating artefacts that the teachers produced and employed in their attempts to resolve challenging situations.

The analytical table was designed to ensure a systematic action-by-action analysis of each of the instances of in-the-moment decision-making and to ensure that inferences about motive-orientations and mediating artefacts would always refer directly to specific sources in the collected data. Instances of decision-making were analysed by filling out the analytical table, first, by inserting relevant data excerpts into the table; second, by summarising particular aspects of those data excerpts; and, third, by making analytical notes about the motive-orientations and mediating artefacts relevant to each of the teachers' actions. The data was also summarised to ensure that the reading of the instance accounted for the teachers' goals and the students' actions.

The summaries in the analytical table also provided an overview of the instance that made it easier to navigate during repeated readings of that instance.

Each row in the analytical table included one teacher action and the layout of its columns guided the action-by-action analysis. In the sections below, each of the table's six columns and the related analytical procedures are described and exemplified. The analytical table comprised the following six columns: (A.) data excerpts from classroom observation describing each of the teacher's actions; (B.) other data excerpts relevant to each of the teacher's actions; (C.) short descriptions of the goal of each of the teacher's actions; (D.) a short summary of the students' actions; (E.) motive-orientations that the teacher attempts to satisfy with each action; and (F.) artefacts involved in each of the teacher's action.

The example developed below includes only one row to illustrate the layout and use of the analytical table. An extended example of the analytical table is therefore included in the appendices, starting on p. 307. The extended example illustrates the analysis of a full instance of in-the-moment decision-making. It covers six pages and shows the same instance as the one used above, the instance where the science teacher Michael is faced with the following challenge: 'Am I doing something wrong that causes the students to misbehave?'

Column A: Data excerpts from classroom observation describing each of the teacher's actions

To achieve an action-by-action analysis of the instances of decision-making, the analytical table was used to sequence the relevant passage of the written classroom observation. A row was assigned to each of the teacher's actions. The example included in the appendices on p. 307 was, for example, split into a total of 20 actions, column A

containing the observation of the instance of decision-making parcelled out into 20 separate rows. One of those rows is included below in Table 6 to illustrate the procedure. In the following, that same row will be used in order to also illustrate columns B, C, D, E and F.

Table 6: Illustration of the Analytical Table's Column A

#	**A. Teacher's actions**	B. Other relevant data	C. Teacher's goals	D. Student actions	E. Teacher's motive-orientations	F. Artefacts used by the teacher
10.	(...) 'One student yells out: You eat them! Michael says: And stop (as in stop talking/shouting answers). Michael "we will not except our learning and our progression of the lesson to be slowed down by (...)" (i.e. noise/interruptions/ students talking).' (...)					

Column B: Other data excerpts relevant to each of the teacher's actions

Column B in the analytical table was used to copy in, or make references to, data excerpts relevant to the teacher's actions. The goal was to make these data excerpts readily available in the subsequent steps of the analysis and to ensure a structured reading of the background data that focused on the particular instances of decision-making. Data excerpts were searched for and added by reading through the post-lesson interviews, the observations of the teacher and documents used by or referred to by the teacher. Some excerpts, for example parts of interviews, proved relevant to more than

one teacher action. In determining relevance, the principle was to include rather than exclude: if something was seen as potentially having relevance to a specific action, it was copied in. Throughout the data analysis, the original data material was repeatedly consulted, not only the excerpts included in analytical table. This also meant that data excerpts were sometimes added to column B at later stages in the data analysis. Table 7 below provides an illustration of how column B was used.

Table 7: Illustration of the Analytical Table's Column B

#	**A. Teacher's actions**	**B. Other relevant data**	C. Teacher's goals	D. Student actions	E. Teacher's motive-orientations	F. Artefacts used by the teacher
10.	(...) 'One student yells out: You eat them! Michael says: And stop (as in stop talking/shouting answers). Michael "we will not except our learning and our progression of the lesson to be slowed down by (...)" (i.e. noise/interruptions/ students talking).' (...)	(...) "Slow to get started, ehm, a bit hectic, but I think it leaves us in a reasonable place for next lesson." (...) (Michael, post-lesson interview)				

Column C: Short description of the goal of each of the teacher's actions

In column C, the data was summed up with a particular focus: to specify and formulate the goals that were guiding each of the teacher's actions. This focused reading involved a shift away from the written observation's third-person perspective to the first-person perspective of the teacher. In interpreting the teacher's goals, inferences were made by attending to the following: (1) the teacher's reactions and responses to the actions of

others and the teacher's reactions to changes to the situation; (2) the teachers' self-initiated actions, for example the initiation of interaction with a student or starting to write something on the whiteboard while students were working; (3) the teacher's actions before and after the specific action that was being interpreted; and (4) data excerpts added in column B, for example from the teacher's accounts in post-lesson interviews. This approach to interpreting goals draws in part on Hedegaard's (2008b) use of analytical tables for analysing observation data. Table 8 below provides an illustration of how the teachers' goals were summarised.

Table 8: Illustration of the Analytical Table's Column C

#	**A. Teacher's actions**	**B. Other relevant data**	**C. Teacher's goals**	**D. Student actions**	**E. Teacher's motive-orientations**	**F. Artefacts used by the teacher**
10.	(...) 'One student yells out: You eat them! Michael says: And stop (as in stop talking/shouting answers). Michael "we will not except our learning and our progression of the lesson to be slowed down by (...)" (i.e. noise/interruptions/ students talking).' (...)	(...) "Slow to get started, ehm, a bit hectic, but I think it leaves us in a reasonable place for next lesson." (...) (Michael, post-lesson interview)	Emphasise a rule for students' behaviour.			

Column D: Short summary of the students' actions.

In column D, a brief summary was made of the students' actions. These summaries in column D mostly involved copying sentences directly from the written observations. The summaries were made to highlight the students' contributions to the situation. This

was done to ensure that the interpretation of the instance paid detailed attention to what the students were doing, viewing the actions of the teacher as an integral part of the ongoing social interaction. Table 9 below provides an illustration of the summaries of students' actions in column D.

Table 9: Illustration of the Analytical Table's Column D

#	**A. Teacher's actions**	**B. Other relevant data**	**C. Teacher's goals**	**D. Student actions**	**E. Teacher's motive-orientations**	**F. Artefacts used by the teacher**
10.	(...) 'One student yells out: You eat them! Michael says: And stop (as in stop talking/shouting answers). Michael "we will not except our learning and our progression of the lesson to be slowed down by (...)" (i.e. noise/interruptions/ students talking).' (...)	(...) "Slow to get started, ehm, a bit hectic, but I think it leaves us in a reasonable place for next lesson." (...) (Michael, post-lesson interview)	Emphasise a rule for students' behaviour.	One student yells out: You eat them!		

Column E: Motive-orientations that the teacher attempts to satisfy with each action

Column E was used to specify the motive-orientations pursued by the teacher in each of his or her actions in the instance of in-the-moment decision-making. As described earlier, the interpretation and formulation of the motive-orientations provided an action-by-action analysis of the demands experienced and responded to by the teacher and the purposes of the teachers' use of external supports. The specification of the motive-orientations was an elaborate process, which is described in detail below. An illustration the result of the process is provided in Table 10.

Table 10: Illustration of the Analytical Table's Column E

#	**A. Teacher's actions**	**B. Other relevant data**	**C. Teacher's goals**	**D. Student actions**	**E. Teacher's motive-orientations**	**F. Artefacts used by the teacher**
10.	(...) 'One student yells out: You eat them! Michael says: And stop (as in stop talking/shouting answers). Michael "we will not except our learning and our progression of the lesson to be slowed down by (...)" (i.e. noise/interruptions/ students talking).' (...)	(...) "Slow to get started, ehm, a bit hectic, but I think it leaves us in a reasonable place for next lesson." (...) (Michael, post-lesson interview)	Emphasise a rule for students' behaviour.	One student yells out: You eat them!	Avoid that students are talking, moving around or making noises. Accept no disruption and slowing down of the lesson and students' learning.	

Three analytical tools aided the inferences about motive-orientations that went into the analytical table in column E in Table 10 above. The first analytical tool was the short descriptions of the teacher's goals in column C. The second analytical tool was an *instance*-specific list of potentially relevant motive-orientations, listing as many suggestions as possible on separate piece of paper responding to the question: what is the teacher trying to achieve in this instance? The third analytical tool was a *teacher*-specific list of potential motive-orientations collated on the basis of an analysis of all of the collected data relevant to each teacher. The analysis of each instance there drew on a holistic understanding of what was important to each teacher. These general descriptions are summarised in the next chapter, which will provide an introduction to each of the five teachers.

The analytical procedures leading to the formulation of the motive-orientations in column E followed these steps:

1. *Read observation:* The written observation in column A was read through in full.

2. *Reread and start instance-specific list of potential motive-orientations:* Column A was read again, this time also reading it along with the data excerpts in column B, the descriptions of the teacher's goals in column C and the students' actions in column D. Through this reading, the instance-specific list was created by formulating potential motive-orientations. Formulations noted on the list were responses to the question: What is the teacher trying to achieve? Whenever needed, background data that was not included in the analytical table was consulted.
3. *Consult teacher-specific list of motive-orientations:* The teacher-specific list of potential motive-orientations was consulted and any motive-orientations that were relevant for the instance were copied onto the instance-specific list.
4. *Summarise goals:* The descriptions of the teacher's goals were summarised by grouping the goals into superordinate objectives and naming these groups. The group names were added to the instance-specific list of potentially relevant motive-orientations.
5. *Action-by-action:* Each teacher action was considered and compared one-by-one to the instance-specific list of potentially relevant motive-orientations. Any motive-orientations that the teacher was interpreted to be pursuing were copied from the instance-specific list into column E. This would also sometimes involve reformulations of these motive-orientations, or include formulations of new motive-orientations that did not already feature on the instance specific list.

6. *Challenge interpretation:* In the final step, the analytical table was read through in a sceptical mode. For each teacher action, the motive-orientations written in column E were challenged by asking questions such as: is this really what the teacher is trying to achieve with this action or could the teacher be orienting towards something else? This sceptical process would often involve many adjustments and reformulations as well as rereading of data, which would then lead to the final formulation of the motive-orientations entered into the analytical table's column E.

Column F: Artefacts involved in each of the teacher's action

In column F, the external supports involved in each of the teacher's action were noted down. As described in the theory chapter, the external supports were conceptualised as external mediating artefacts, including physical objects, spoken language, written language, visual depictions, gestures and sounds. As also detailed in the theory chapter, artefacts carry meaning and physical features that make these entities useful as tools for action.

Column F was used to note down any artefacts that were part of the action carried out by the teacher. The artefacts included in each row of column F were those that the teacher used as part of the particular action described in that row. It included the artefacts by means of which the teacher achieved the operation of each action. As evident from the example below in Table 11, and from the full example in the appendices p. 307, the separation of the instances into a sequence of actions made it

possible to summarise the teacher's use of artefacts in Column F by describing those mentioned directly in the observation excerpt in Column A.

Table 11: Illustration of the Analytical Table's Column F

#	**A. Teacher's actions**	**B. Other relevant data**	**C. Teacher's goals**	**D. Student actions**	**E. Teacher's motive-orientations**	**F. Artefacts used by the teacher**
10.	(...) 'One student yells out: You eat them! Michael says: And stop (as in stop talking/shouting answers). Michael "we will not except our learning and our progression of the lesson to be slowed down by (...)" (i.e. noise/interruptions/ students talking).' (...)	(...) "Slow to get started, ehm, a bit hectic, but I think it leaves us in a reasonable place for next lesson." (...) (Michael, post-lesson interview)	Emphasise a rule for students' behaviour.	One student yells out: You eat them!	Avoid that students are talking, moving around or making noises. Accept no disruption and slowing down of the lesson and students' learning.	The word "stop". Verbal formulation of a rule about the activity as a whole (no slowing down).

The procedures relating to the analytical table outlined above may unintendedly give the impression that the analysis only considered isolated, observable behaviour. However, while the analytical table guided the analysis towards an action-by-action unpacking of the instances of in-the-moment decision-making, this micro-level focus was adopted as a way to ensure a fine-grained understanding of each instance and of the teacher's decision-making. The interpretation of each individual action only became possible in the analysis by relating the specific action to the actions that came before and after it, and by interpreting the action in relation to the instance as a whole, to the lesson within which the instance occurred, to the post-lesson interview reflections from the teacher and to the understanding of the context gained from the observations, interviews and documents conducted in the school more broadly. For example, as mentioned above, the examination of the specific instances was preceded by an analysis

of what was important to each teacher, an analysis that will be presented in the next chapter before moving on to the unpacking of the decision-making instances.

It is also important to note that while the analysis prioritises a high level of temporal specificity to capture the teachers' use of artefacts, this bottom-up focus on action-by-action unfolding of decision-making should not be taken as a denial of the complex set of factors that could help explain why particular teaching situations emerged as problematic for each of the teachers. However, the analytical approach intentionally 'flattens' the analysis in order to bring to the fore *how* the teachers managed to resolve challenging teaching situations. Instead of coming to the instances from the outside by conducting a historical analysis of the culture and traditions of the particular institutional practice to understand why challenges emerge, which has sometimes been a focus in cultural-historical studies (Hedegaard, 2012a), this research project provides a fine-grained analysis of the teachers' artefact use, an analysis that was enabled by focusing on the moment-by-moment unfolding of interaction within the instances themselves.

4.5 Conclusion

A key part of the data analysis was the navigation between different instances of in-the-moment decision-making. The sections above provided a detailed account of how each instance was identified and systematically unpacked through the analytical table. The analytical process described above provided several instances per case teacher. The overview in Table 12 below outlines the instances of in-the-moment decision-making identified for each of the five case teachers. Table 12 gives an overview of the instances of decision-making that the teachers engaged in during the observed lessons. The names

assigned to each of the 25 instances provide an initial sense of the different kinds of decisions the teachers were making. Table 12 also provides a reference point for the detailed accounts presented in the findings chapters (chapters six and seven).

Table 12: Instances of In-the-Moment Decision-Making That Were Identified and Analysed

Teacher	**Instance**
Brian (history)	- Sorting out instruction for task - Brief plenary or extended writing task - Letting students decide whether to move or to pass around information - Girl not wanting to give up her phone - Missing a PowerPoint slide with answers to task questions
Emma (English)	- Graph on character's attitude to poetry took longer - Strong characters among the students dominate the task - The 'dreaded PEE paragraph' - The starter activity takes too long
Michael (science)	- Wrong answer giving points - Running out of activities and having extra time at the end of the lesson - "Not the nicest bit of learning" to sit quietly going over a test - Not sure whether he has taught it before - Am I doing something wrong that causes the students to misbehave?
Isabel (languages)	- Realising that they had done some of the starter task before - Stand and talk in a circle was not planned but spontaneous - Stop and restart interaction task - The game at the end was a kind of last minute decision
Richard (mathematics)	- The Italian restaurant task that never was - Students had forgot about squares or factors - Needing to explain one more thing - Making a show with jokes - Half of the students are away on a field trip - Task about application of Pythagoras is squashed at the end - The students all need to have something to do

As will become apparent in the findings chapters, the similarities and differences between the instances of decision-making provided rich grounds for theory development. The goal was to develop concepts that would allow for descriptions of

both the commonalities and differences between the teachers as well as between different decisions made by the same teacher. The variation between the analysed examples continuously challenged the developing concepts as the analysis proceeded. Any dynamics or patterns suggested needed to describe well the decision-making of all of the five case teachers, and not only account for single instance or a subset of examples. This requirement to span differences between examples made it possible to move between, on the one hand, suggesting new refinements of concepts on the basis of a single instance and, on the other hand, proceeding to challenge and refine such conceptual suggestions by checking whether they accounted for the rest of the observed instances.

The use of the analytical tables and an overview of instances like the one in Table 12 made it easy to navigate between instances and between teachers. The systematic layout of the analytical table made it possible to return repeatedly to the details of each instance when assessing similarities and differences in the case teachers' decision-making. It enabled the continuous suggesting and challenging of conceptual ideas, using the overview of all of the instances as a way to systematically check whether concepts were descriptive of each case. The overview also supported the maintenance of the case-level perspective, assisting the formulation of the dimensions on which the teachers differed from one another in their decision-making during the lessons they were observed.

The two findings chapters, chapters six and seven, provide descriptions of the five case teachers' decision-making and presentations of the concepts that enabled the case descriptions. Chapter six deals with research question one: *What role does schoolteachers' use of external supports play in their enactment of in-the-moment decision-making?* Chapter seven presents the findings relating to the second research

question: *How do physical and cultural circumstances of teaching situations enable and constrain schoolteachers' use of external supports during in-the-moment decision-making?* Chapter eight will discuss the findings in relation to the research literature and consider the potential implications for practitioners.

Before going into the findings about the teachers' use of external supports, the next chapter provides a background presentation of the school setting and each of the five case teachers, focusing on what was important to them in their teaching.

5 The Case Teachers and the School Setting

This chapter provides an introduction to the school setting and the five case teachers. The goal of the chapter is to give sufficient background before moving on to the case analyses in the subsequent chapters, which will focus specifically on the teachers' use of external supports during in-the-moment decision-making. The present chapter presents the background analyses of the teachers and the school which aided the analysis of specific instances of in-the-moment decision-making. As described in the methods chapter, these background analyses relied on observations of lessons, meetings, breaks, morning staff briefings and professional development days at the school. This data was supplemented by the interviews conducted with the five case teachers and the school management as well as a wide range of documents from the school and about the school.

The presentation of the school setting highlights salient institutional objectives and the corresponding demands facing the teachers working there. It follows the conceptualisation of motive-orientations which was described in the theory chapter and which was derived from Hedegaard's (2012a, 2012b) theory of motivation in institutions. This focus was part of achieving a better understanding of what was important for the teachers working in the school, and it provided the backdrop for the later interpretations of the case teachers' motive-orientations during specific instances of in-the-moment decision-making. Furthermore, as a background for understanding the conditions under which the case teachers were using external supports, the presentation

of the school setting also very briefly describes the students, the collaboration between staff, the professional development activities and the physical space in the school.

The presentation of each of the case teachers is also structured according to Hedegaard's (2012a, 2012b) theory about the interplay between personal motives and institutional objectives. It thus foregrounds salient personal motives as well as the teachers' different orientations to school objectives, to objectives from their subjects and orientations towards demands from their students. By bringing to the fore what generally mattered for each of the case teachers in their teaching, these descriptions serve as important background information for understanding the teachers' decision-making and the motive-orientations they sought to satisfy. To provide further background, the teacher descriptions in this chapter also include brief details about their roles in the school and their levels of experience along with short accounts of how they described their lesson planning and their reasoning about teaching.

5.1 The School Setting

The school had undergone a lot of change in the years prior to this study. Three years earlier, this inner city secondary school had closed down and reopened under a new name with a new principal. Most of the school's staff continued to work in the school. The local media and the new management team celebrated the turnaround that the school had undergone, which was accompanied by positive evaluations from the national inspection unit Ofsted. At the time of the study, the new principal was communicating very clearly that the improvements achieved should be followed up by further improvements, sharing a clear vision of creating an 'outstanding' school.

The sense that the school was doing well was shared among the teaching staff, who stressed the importance of their students' progress on exam results. The teaching staff were generally happy to work at the school, which was also evident from the fact that the school had higher staff retention than the neighbouring schools. While the teachers seemed to enjoy being part of the 'success story' of the school turnaround, it also meant that there was a high pressure on the teachers to ensure that their students were performing well in assessments and exams. The management team was communicating an expectation of continuous improvement. This extended not only to students, but to the teachers as well. The accountability structure, within which the teachers were working, was performance-based, focusing on students' exam results as the key measure, expecting the teachers to do their utmost. Teacher performance was monitored through elaborate student assessment data. Teaching practices were targeted through teaching observations and professional development logbooks and activities.

The teachers were not opposed to the high expectations and performance management structures driven by the senior management team. While all of the case teachers recognised that they were facing considerable workloads and limitations of time, they shared the high level of ambition for their students and a commitment to continuous improvement, which was promoted by the school management. Although the charismatic leadership from the school principal was notable, continuous improvement was pursued as a collective endeavour. The alignment between the objectives of the senior management team and the understanding of the teachers is evident from the following reflection from the mathematics teacher Richard, and it also expresses the key focus on students' exam results:

> "Well, in the current environment more than ever, we have to be outcome focused, okay. So the school's judged on results, as

> teachers we are judged on results, departments are judged on results." (Richard, interview)

The focus on student results was coupled with clear expectations about student behaviour, an ethos that every student should strive to be the best versions of themselves and extensive pastoral care activities. The pastoral care activities were centred around a house system, which provided opportunities for students to earn points for their respective houses. The house system also provided a backdrop for competitions and celebration of students' achievements in sport, poetry, theatre and more.

A high proportion of the students came from lower socio-economic status backgrounds with an above-average number of students on free school meals and a high number of students with English as an additional language. The approximately 1000 students, of whom 200 were sixth formers, seemed to, largely, have taken on the expectations about behaviour and a focus on learning. Both during lessons and at break time issues rarely arose, and teachers new to the school pointed out the students' good behaviour compared to their previous experiences elsewhere. There was a general sense that the students were happy about their school, and that they, at least to some extent, were also taking on the 'success story' of being part of a school that was doing particularly well.

Generally, each teacher had their own classroom, with students moving around the school. Different departments were clustered in different parts of the school and on different floors. Students would start their day with five minutes of registration with their tutor group and tutor teacher, with whom they would also spend 30 minutes after the lunch break. For their lessons, students were grouped into sets and they therefore split up after registration and tutor time in order to get to lessons which were grouped on the basis of ability.

The school buildings were spread out, with big sports grounds and some older building as well as several newer facilities. A reception was the gateway for visitors like researchers, and the importance of wearing a visitor's badge was stressed multiple times by the school management. Both staff and students were, however, very used to visitors, some of whom came to see this school that had managed to turn failing results into marked success.

All of the staff would get together for morning briefings in the main staffroom at least two times weekly. There were no visible grouping or cliques among the staff, and friendly small talk and conversation were present amid the hurry of getting to classrooms and getting ready for lessons. The other important meeting points were in the various departments, many of which had their own small staffrooms or tea kitchens. Collaboration between staff was widespread in the school. Some of the collaboration was coordinated through departments, for instance in the science department which collaborated on lesson planning. Staff collaboration was pivotal in the professional development activities organised and monitored by an assistant head teacher. The senior management team had decided to rely on peer-based professional development activities, drawing on the expertise within the school and promoting peer-observations.

Beyond the formally coordinated collaboration, other teachers and members of the management team would often walk into classrooms during lessons, for instance to borrow equipment, ask about something or show visitors around. The teachers did not seem to regard their classrooms as private or closed off domains. This openness also, as mentioned in the methods chapter, made it easier to arrange classroom observations for this research project. As several of the teachers noted, they and their students were very used to people coming in to observe.

5.2 The History Teacher Brian

Brian had been working in the school the previous year during his school-based initial teacher education. Hence, despite it being his first year of teaching as a young newly qualified teacher (NQT), Brian already knew the school well and he was well-integrated into the humanities department. He had a good working relationship with the head of the humanities department who seemingly had taken on the role of mentoring and supporting Brian. In the lessons observed for this study, Brian was teaching the lower year groups Year 7, Year 8 and Year 9 with students aged between 11 and 14. Like the other history classrooms, the walls of Brian's classroom were covered in colourful posters detailing and illustrating historical events, periods and concepts.

Brian several times emphasised that he built up his lessons by working backwards from an intended outcome. Brian explained that he would first specify desired outcomes and then find and prepare tasks accordingly. In this way, Brian set up his lessons for the students to acquire selected history knowledge and to practise specific history skills and understandings of certain history concepts. Brian exemplified his reasoning about outcomes as follows:

> "So if I know a particular group is weak in note-taking or is particularly weak in making inferences, I might give them more lessons which are that way loaded, so basically they got more chance to progress and practise on that." (Brian, interview)

Brian's lessons tended to revolve around one main task in which students would access and process information about historical events. Students would, for instance, access information from paper slips prepared by Brian, from textbooks, from a video displayed in the classroom or from internet searches when a lesson was taken to a

computer room. The processing of the information took different forms, for instance answering questions, formulating questions, creating dramatisations, comparing time periods, or writing stories and diary entries. Tasks were mainly group based and they were often accompanied by students writing individually in their books.

The way Brian tended to spend his time in the classroom reflected his focus on the realisation of planned tasks to achieve particular outcomes. Much of Brian's time was spent setting up tasks and keeping students on task, either by giving instructions, managing timings or correcting students' behaviour. Plenary discussions as well as questioning and answering mainly took part briefly at beginnings and ends of lessons. Brian seemed to prioritise the progression of planned tasks over opportunities to expand on ideas and questions from students, often in situations where time pressure was building up towards the end of the lesson. This is illustrated in the following example from a lesson on the Saxon justice system, where Brian closed down discussions of student presentations to gain time for the planned comparison of justice systems and for students' independent writing:

> 'Brian explains the trial by hot iron: That they burn, wrap up, see if it has started to heal and that it was a way to see if God wants it to heal. One student says: That does not…? Brian says at the same moment as a response: These do not make sense. One or two other students also comments on this. Brian says: We are in the sixteenth century, there was no logical system for trials. He then asks the students to write down a description of trial by hot iron in their books.' (Brian, observation)

Brian highlighted that he wanted to improve his timings on tasks to ensure a better fit between his planning and the actual lessons. Brian stressed that he was still

learning as a newly qualified teacher, referring to the need to experiment and built better systems around timings. He described the challenge of timing in following way: "I always kind of run out of time, which is fine, but it's not ideal. But that's just me improving my time management stuff of the lesson to be honest and just making things a bit tighter and sharper."

Brian was very attentive to differences between students. Several times, he stressed the need to experiment to get to know how different students would respond and work on different tasks: "I am kind of learning more how different approaches are working with different people and getting what I want out of them." For instance, Brian emphasised the value of an information search task in highlighting "who is more resilient in terms of independent working" and "who is more capable in terms of independent research and who isn't." Brian took care to differentiate tasks by grouping particular students, by differentiating the information they were working on and by setting questions that could be answered at different levels of depth.

Another important point of attention for Brian was to get the "learning behaviour" right for every student. He noted that he needed to develop his behaviour system. Three months into the school year, he made the following reflection:

> "I suppose I am strict– well harsher in some respects with punishment stuff, so I tightened up a bit on my behaviour management. And the expectations in the room. But, it's an ongoing process. It is all kind of continuous development." (Brian, interview).

In the lessons observed for this study, students did challenge Brian. Brian very often had to repeat instructions and reminders about behaviour, sometimes without the intended effects. Brian used a series of techniques, including counting down from three, ringing a

small bell and using warnings about staying behind after lessons. Brian's responses to students were always calm, often including waiting and, at times, not saying or doing anything at all. While the students, as Brian himself noted, were pushing and testing him, he often sought to calm down students, maintain order, avoid what he referred to as "silly behaviour" and make sure that students were "reinforced in their doing what they should be doing all of the time all the way through in there."

5.3 The English Teacher Emma

Emma was in her first year of teaching, teaching English as a young newly qualified teacher (NQT). She had done her postgraduate certificate in education (PGCE) the year before. She knew the school well from her training year because she did two of her three placements there. In the lesson observed for this study, Emma was teaching year 7 students that were around 11-12 years old and the youngest year group at the school. Emma had built a close relationship with the groups of students she was teaching. She nearly always had a smile on her face. Rather than seeming under pressure or burdened with the teaching work, she came across as energetic and with a positive outlook.

Emma was well organised. It was important to her to have lesson plans and slides ready in advance and to, as she stressed, avoid "sitting the night before." Often, she would have planned more tasks than there would eventually be time for in one lesson. In those cases, she tended to prioritise letting students work at their pace and instead postpone. For instance, this was her approach when a paragraph-writing task took longer than expected:

> "I definitely didn't want to rush it, I wanted obviously quality over quantity so that is fine, that will just kind of roll over into

> tomorrow's lesson and we will start with that [...]. So, I wasn't worried about that at all, but I had it there just in case they had moved quicker. Sometimes you can't predict the pace of the lesson. It is always better to have a next task to do, in case for some reason everyone is working really quickly one day." (Emma, interview)

Within lessons, Emma was incorporating a number of systems, some of which her NQT-mentor had suggested she should try out. For example, Emma introduced an elaborate token system to encourage students to speak more in class, in which students would get rid of a plastic token per contribution to plenary discussions. Furthermore, Emma was generally making an effort to, and stressing the importance of, clear communication with her students about the objectives and success criteria of tasks. In designing tasks, Emma often took care to systematically align tasks with upcoming assessments, seeking to make students comfortable and familiar with the requirements they were going to face.

Emma was very attentive to how the students were feeling in the class. She wanted to make sure that the students were enjoying the tasks in a safe and positive environment. For instance, she would point out and reflect on the students' confidence in working with different tasks, like in the following post-lesson reflection:

> "I noticed that some people who weren't here yesterday felt a bit threatened [...]. I think that was because they had such good examples and were comparing their own to those so, they probably felt a bit less confident because they missed lessons." (Emma, interview)

Gauging the attitudes of the students was an important focus point for Emma. She would adjust her lessons depending on the mood of the students that day, for instance by waiting to see if the students were in the mood for more writing, or needed to do a different task. Likewise, if the students seemed to enjoy working on a task, Emma tended to prolong it rather than interrupting the students. Her attention to students' attitudes was not, as Emma pointed out, a matter of trying to please the students. Rather, she saw this as important in terms of keeping them engaged.

Emma stressed the importance of having students share their ideas, often seeking out good examples and praising the students for their contributions. Despite many of her lessons being more structured, Emma valued giving students' opportunities to pursue their own ideas. Many of her students seemed to enjoy such opportunities, with some of them, as Emma reflected, being "more than willing to kind of steal the show." Emma clearly enjoyed seeing what the students would come up with. She wanted to ensure that at least some of the lessons were more creative. This orientation to freer and more creative lessons was, however, pressured by limited time, especially during the term that Emma was observed:

> "I would have loved to have done some more creative stuff with it [the term] rather than just solely analysis. They could have created their own play of the film, they could have done lots of drama, lots of creative writing, poetry, all different English forms, but we are constrained by time and typically you are supposed to finish each unit of work before the end of term." (Emma, interview)

Emma stressed that she was often impressed with what her students were able to do. For instance, she was positively surprised to see how well her students understood a

set of poems that would usually be considered too advanced for that year group. Rather than being satisfied with the students' abilities, she, however, wanted to push the students to see how good they could get. Although pleased with the students' writing abilities, she wanted to include even more writing tasks:

> "So I don't think we need the practise. But I want, I suppose it is curiosity, I want to see how good they can get at it so early on, so I am kind of excited by how good they are and I want to keep pushing them and see if they can develop it even further." (Emma, interview)

5.4 The Science Teacher Michael

Michael was part of the school's science department and he was referred to by the principal as a "lead learner", i.e. an expert teacher taking a leading role in the continuing development of teaching and learning in the school. Michael was running one of the three weekly morning professional development sessions in the main staff room. His sessions were about differentiation, where he presented ideas, asked colleagues to share techniques, facilitated short discussions and assigned teaching methods for the participants to try out. As the literacy co-ordinator in the school at one point remarked, Michael was one of the "young guns" that the principal wanted to lead the peer-to-peer professional development in the school.

Jokes and humour were important for Michael. Funny remarks and banter was a central part of his interaction with other staff. Also during lessons Michael frequently sought humorous opportunities, both in plenary presentations or when interacting with students individually or in groups. For instance, Michael at one point made an

impression of a character from a movie (Doctor Evil from the movie *Austin Powers*) and then followed this up by finding a clip online for the students to "reflect upon" and for them to "appreciate" the quality of his Doctor Evil impression.

Jokes were sometimes directed at specific students, like in the following example:

> 'Michael is asking one group what variable they are going to use. Michael is talking to students in the group. Michael says as a joke to one student: Oliver, did you use the F-word? (pause) Force (as in saying that the F-word was force)! The student first looks surprised, then some students in the group laugh and some of them comment on the joke, including the boy that initially said force before Michael commented.' (Michael, observation)

Michael was aware of the central role of humour, commenting prior to the first lesson observation made with him that the main thing to see would probably be him making a lot of bad jokes. At times, Michael was also pointing out that he went a little bit too far. This was for instance his reflection, when he, as part of a practical joke during a break, accidently made one of the older students drop a bagel sandwich on the floor.

Michael was oriented towards demonstrating ideas to his students. He emphasised that it was important for the students to build up an intuitive understanding, rather than only following rules and procedures for getting questions right. Part of Michael's rationale was that without the intuitive understanding (for example of the differences between series and parallel circuits) there would be too many rules and details for the students to remember. Several times, Michael stressed that he saw his main role as helping the students connect information and ideas, while he depended on the students to work to learn and remember the details. Michael made this clear to the

students as part of motivating them to work in lessons and on homework. Accounting for his approach in a post-lesson interview, Michael explained: "I split it down into two parts." Michael described the first part as the "bits they [the students] just needed to learn, that I couldn't help them to learn, it's just information, building blocks if you like, where if they don't just know it they gonna struggle with piecing it together." The second part, which he saw as his main responsibility, was "the explanations they didn't understand and how could we put those blocks together, what analogies we could use to do that."

The orientation to demonstrating ideas was clearly evident from the lessons. Oftentimes, Michael sought to engage students in the core ideas of a topic by setting up memorable, remarkable and fun illustrations. For example, Michael asked his students the following question: Who would win a fight, mass or weight? The explanation of the difference between mass or weight was also, in the same lesson, aided by asking one student to stand on one of the classroom tables and asking questions about why he did not fall through the table. In another example, the difference between series and parallel circuits was explained with the analogy of comparing a supermarket with one cashier to a supermarket with multiple cashiers, where customers resembled electrons needing to get through the cashiers. In this example, Michael asked students to get up from their chairs and invited them to play the roles of shoppers (electrons) and cashiers (resistance) respectively. Yet another time, the idea of plants' competition for resources was taught by asking the students to design and draw their own "super-mega-wonder plant":

> 'Michael asks one student: "If you, Ibrahim, were a plant" what would you have? Ibrahim says: A flamethrower. Michael repeats this and smiles. Michael comments that then he can have his

> "meals hot." The student says something about chicken. At least two other boys are looking up, one of them commenting something. Michael asks Ibrahim: "How would you attract the chicken?" Michael also says that he would need to be big.' (Michael, observation)

During independent student tasks Michael was focused on making sure that students were working, seeking to pressure them to stay on task and give it their most. For instance, towards the end of a lesson where students were working in their books preparing for an upcoming test, Michael encouraged students to keep going by saying: "You still got five minutes of learning time. There is still time to start something." At the end of the same lesson, he praised the students by saying: "You are all working very hard, that is very good." Similarly, towards the end of a different lesson, Michael attempted to keep his students working:

> 'Michael: So, we are going to that stage where some of you think that you are finished. "You should never finish" (said in a dramatic, serious voice). You should be going over the questions. You should be examining; how much is each question is worth? Some of the questions are long. Can I give more details? Are there any clues in the questions? You should be asking: Is there anything more that I can do? You need to be constantly scanning your minds. See what you can do "to get yourself marks." "You should never finish" (said in a voice that sounds like he was guiding a meditation session).' (Michael, observation)

Michael made sure that any, to him, problematic student behaviour would be followed up with immediate consequences. To the students, Michael emphasised that poor behaviour was "not fair" and "selfish". He was letting students know that it "is about respecting everyone else in the room" and that no one should be "exempt from the possibility of achieving" due to interruptions from others. Consequences for the students included being moved to a special table, an option that Michael would also mention to students as a warning. Another option was sending students out or keeping students for a little while after lessons. At times, students would openly complain about their punishment, like in the following example where a student is kept after a lesson:

> 'Michael to the student that ripped the book cover apart during the lesson: "You are totally showing lack of respect." Michael then says to the student: "Sweep the floor, it is part of you beginning making it up for the book." The student says to Michael: "You ripped it out, and then you are keeping me in!" (said as in protest, as in saying: it is not fair). The student takes a broom and uses it for approximately 45-60 seconds, after which he leaves.' (Michael, observation).

Michael was often following a teaching plan which set out core topics, concepts and ideas for tasks. Michael had developed this plan over the last four years, some of it in collaboration with other teachers from the science department. In one post-lesson interview, Michael reflects on the benefits of the prepared lesson plans and PowerPoint slides:

> "I have written them myself within the last four years, so the ones I have designed I know why they are there, they are tailored to my style of teaching and I have used them many

> times so I can turn up and teach the lesson just with zero prep time because the prep time has been done before and tweaked over the years." (Michael, interview)

When following the prepared lesson plans, the overall structure of Michael's lessons was clear, with Michael seemingly being very clear about what he wanted to achieve. However, his planning seemed much less detailed when it came to the specifics of what to say and which resources to use. Often, Michael would take opportunities during a lesson to do a couple of minutes of preparation for the next lesson, for example while students were working independently.

5.5 The Modern Foreign Language Teacher Isabel

Isabel was in her fourth year of teaching modern foreign languages. She was teaching mainly Spanish, but also French and German. She was pointed out by the assistant head teacher as an experienced language teacher. In the Friday morning professional development briefings, Isabel was highlighted for her abilities in differentiating teaching to match variations in student abilities: "I am supposed to be one of the best differentiating teachers." Isabel tended to plan her lessons individually and often used breaks and transitions between lessons to get ready. However, she seemed at home both among the other language teachers and in interactions with other staff. She would for example, during one lesson, quickly go to the neighbouring classroom to borrow sets of dice and she was often seen chatting briefly with colleagues in the main staff room.

Isabel taught across the year groups, from year seven (11-12-year olds) to A-level students (16-18-year olds). While her lessons with the younger students were often very crowded with up to 32 students in the room, classes with the older students had as

few as five students. Seemingly entirely comfortable with all groups of students, Isabel in particular enjoyed teaching the smaller groups of more advanced students where they were able to get into more depth, both with the language and in terms of the content of their discussions. She highlighted that the big groups of students gave rise to demands for organising the classroom space, firm behaviour management and clear communication of her expectations.

Isabel emphasised the importance of taking into account students' previous learning, planning lessons logically to build on previous learning and continuously assessing students' abilities. Her reasoning about "logically planned lessons" is illustrated in the following post-lesson interview excerpt:

> "So taking into account their previous learning. They had just learned items, itemised language for weather the week before, the lesson before. And I started out with a starter that recapped that. Very easy for them. That was really to kind of gage their knowledge and you know how much they remember. And it was very obvious to me that they had no problems recognising the language. But then I think it was important to give a bit of time to practise that orally. Because students are often very good at recognising but not very good at pronouncing and saying the words out loud. [...] So the stages after that was to build on that language, you know, moving away from weather to little paragraphs about the country somebody is from, so it is recycling that and building on what they've got." (Isabel, interview)

The excerpt above also indicates Isabel's orientation towards covering all of the language skills: writing, reading, speaking and listening. She stressed the importance of ensuring that her students practised all four skills and her lessons tended to involve many shorter tasks alternating between these skills.

Isabel was very aware of the challenge that the mixed ability of the students posed on her teaching. Her Spanish classes included both native Spanish speakers as well as a number of students with a Portuguese-speaking background for whom learning Spanish was considerably easier. Especially in lessons with big groups of students, particular students were very eager to answer and they would often get frustrated when asked to give the others a chance. Isabel also pointed out the danger of students getting bored in her lessons because they were not challenged. The comparably higher abilities of some students, according to Isabel, were also sometimes lowering the confidence of the rest of the class.

It was important for Isabel to help her students become independent learners. She emphasised how she would establish this expectation early on: "I make it very clear that they all get more out of learning, the more independent they become. So it is not about me spoon-feeding them, it is about them looking for the language." In the lessons observed for this study, Isabel would repeatedly encourage students to challenge themselves and to seek support from resources such as dictionaries, wall-displays and vocabulary and grammar written in their books. Encouraging and relying on students' independence was a key strategy for dealing with the mixed ability of her students. The following observation excerpt from one of her French lessons provides an example of this strategy:

> 'Isabel: "Those of you who are already at that level, there are more connectors over there." Isabel is referring to a poster with

> a list of words which hangs on the board to the left side of the whiteboard. Isabel says that the students have ten minutes to write. The task is described on the whiteboard using the projector. It reads: "Préparer un exposé" with more text. Isabel describes the task. Isabel mentions four student names and says that these four students "should challenge yourselves." She adds the name of a fifth student by saying: …and [name] maybe as well.' (Isabel, observation).

Although there were low levels of disruption in Isabel's lessons, student behaviour was an important point of attention for Isabel. Isabel stressed the need for her to make her expectations about behaviour clear to the students, and she pointed out how this was particular central when teaching big classes in the small space of her classroom. She also noted that her "classroom control" had become "firmer" over her four years of teaching. Her lessons included various systems through which student behaviour was managed, including for instance counting down from three, numbered warnings, moving students, sending students out and keeping the whole class for extra minutes.

From following and observing Isabel working, it was clear that she was under time pressure to get her lessons ready. She would, for instance, use almost all of her breaks and transitions between lessons to plan. She also taught a very full teaching schedule and preferred interviews to be at the end of the day after the last lesson. She mentioned the work load of marking students' work, saying that she worked every weekend. Occasionally, she did mention more planning time as a way to improve her lessons. She also, sometimes, apologised to the students for things she had not prepared, for instance things she had not printed or remembered.

Isabel's workload, in terms of preparation, was eased by using a comprehensive online teaching resource and having a big repertoire of activities. She explained that she would often spontaneously add tasks that she had not initially planned. The comprehensive online teaching resource had numerous readymade tasks. When relying on this resource, Isabel displayed descriptions, vocabulary and visuals for tasks tailored around particular themes and topics. Furthermore, the resource allowed Isabel to play audio for listening tasks. Isabel supplemented the online teaching resources with PowerPoint slides and frequent writing on the classroom boards. The online resource, however, did help Isabel save time, as she points out in a post-lesson interview:

> "I actually used an existing resource which meant that I didn't have to create material. I didn't have to, you know, write things or cut things up. It was an easy preparation in that sense." (Isabel, interview)

5.6 The Mathematics Teacher Richard

Richard was in his seventh year of teaching mathematics. He came from a background in business with a degree in economics, changing career to teaching where he said he was planning to stay, calling it a time to give back to society. Richard was mostly teaching lower ability sets of students in their final years (year 10 and year 11), often mentioning how he was motivated by providing his students with better opportunities in their lives. Richard explained that his main goal was to ensure that students come out having as good results as possible. He wanted to help avoid that his students, later in their lives, would face the obstacle of having a bad mathematics exam and the challenge of not having learned mathematics.

Richard laid out his motivation for teaching in a conversation with one student before a morning lesson. Characteristically for Richard, he first made a funny remark but then followed up with a more serious and elaborate answer:

> 'The student Daniel: "What gets you up in the morning to get down here to teach me?" Richard: "The holidays." Richard is handing out books while talking. After five seconds Richard says: "You Danny, not letting you down." Daniel asks: Yeah? Richard says: "Yeah, sounds so fine." Richard pauses for another 3-4 seconds, still handing out books. Richard then says: "It is called a job, Danny, you are supposed" to do it, "it is a thing called duty", "and public service", "something that is of value to society, something that might actual" benefit others. Richard says that he works "to give you [Daniel] more choice." Richard then explains, saying this straight after: "Basically, I have had a lot of choice." Richard: I've got a degree; my two brothers haven't had the same possibilities.' (Richard, observation)

Richard was charismatic and a character who came across as a little reserved at times, while friendly and talkative at other points. Sometimes he could be moderately intimidating, for instance when making dismissive comments about ideas shared at the teacher-led professional development sessions or when making clear that he found the sessions to be a waste of his time. He wore a suit and shoes that were both more formal than most of the teachers but also a more distinct, for instance with pointy leather shoes and a dark suit with bright stripes. As he told me after one of his lessons: "You need to be yourself", and he explained that this was

important in order for the students to relate to him, saying also that the personality of the teacher is very important.

'Being yourself', for Richard, involved making funny and remarkable comments during his teaching, seemingly to catch students' attention, make the content less dry, relate to the students' experience and show his personality, rather than being an 'empty' person. Jokes and comments were often related directly to the subject matter content Richard was presenting. For example, he would make references to a well-known rap song and draw "trailer trash girls" and a "dealer" on the board as part of explaining and reminding students about procedures for calculating surface areas and perimeters of rectangles.

While humour was an important part of Richard's teaching, he would also use opportunities to have conversations with students about other things, for example by talking to one student who was sharing that he had problems with pain in his back. Interaction with students one-to-one was a key part of Richard's teaching, supplementing his energetic and fast-paced plenary presentations and explanations. Interacting with students was directed at building a good relationship with the students, assessing where they were on their tasks to provide individualised instructions and giving help and explanations relating to the subject matter content.

Richard often reasoned in a cost-benefit analysis mode, stressing the need to be realistic. For instance, he assessed how much curriculum they would be able to cover, comparing this to what would eventually help the students get the best grades. Richard endorsed a high-priority focus on students' exam results, explaining how the focus on exam results structured his planning and teaching:

> "Pretty much after we've done a first mock [exam] at the end of year 10, so, before I start teaching them beginning of year 11, I

> am thinking what group have I got, what outcomes am I hoping for, what is the best way of getting them the best possible outcome?" (Richard, interview)

Richard saw students' test results as an important focus, recognising that exams became the dominant focus towards the end of the school year, while also stressing that good results were the product of the concerted effort of all the teachers in the mathematics department across all of the students' time in the school.

Richard emphasised the importance of making sure that he spent his energy in the classroom with the students. Rather than focusing on planning and preparation, he sought to make interaction with the students and assessment of their needs the key focus:

> "I wanna be teaching twenty years and not the next two years and if I'm gonna give my best to the students, I have my energy in the classroom, not my energy spending my evenings night-time, you know, like some teachers do, pouring over the best resources, because I tend to find that the more you do that, the more invested you are in delivering your material, the less energy you give to actually teaching, hence the more obsessed you are with following what you planned, rather than actually interacting with the students. It's a lot easier to do that once you've taught something a few times." (Richard, interview)

5.7 Conclusion

All five teachers were focused on the learning of their students, and teaching well was clearly important to all of them. They were working intensively at a fast pace with long

working hours and weekend work. They all had to balance notable time pressure against the quality of their planning and teaching within a school that attended carefully to the performance of each of its teachers.

Apart from teaching different subjects, the teachers also came from different backgrounds and had different levels of teaching experience. Brian and Emma were in their first year, Michael and Isabel had taught for some years and Richard drew on seven years of experience. While Michael and Isabel were covering the range of student year groups, Brian and Emma were mainly teaching younger students and Richard was teaching older students.

There were differences in the ways the case teachers related to their work at the time this study was conducted. Brian tended to be focused on realising the often elaborate tasks he had planned for his students. Emma often changed her plans during lessons but mostly in order to avoid interrupting her students when they were working well. Michael wanted to ensure that his teaching was effective by keeping a high pace and responding quickly to obstructions to the progression of lessons. Isabel structured her lessons to fit the learning needs of her students but she was often challenged by limited planning time and issues arising from having to rely on many improvised tasks. Lastly, Richard had found ways to reduce his planning, prioritising spending his energy in the classroom continuously seeking out opportunities to extend his students' abilities.

This chapter's presentation of the school setting and the case teachers provides the foundation for the findings presented in the following chapters. First, the background information makes it easier to follow and evaluate the analysis of the teachers' use of external supports during in-the-moment decision-making. It does so by laying open the understandings of the case teachers: understandings that were drawn on in the interpretation of specific examples of their in-the-moment decision-making.

Second, the information above outlines the differences that the developed concepts needed to span and account for. As described in the methods chapter, the in-depth analysis and comparison of similarities and differences between cases provided productive challenges in the theory development process: the concepts needed to account well for both the similarities and differences between the teachers' decision-making. The following two chapters will present the concepts that were developed in the analysis and the descriptions they enabled, focusing on the role of external supports (research question one) in the next chapter and on the conditions for support use (research question two) in chapter seven.

6 The Case Teachers' Use of External Supports

While the previous chapter provided background descriptions of the school and the five case teachers, the present chapter zooms in on the teachers' in-the-moment decision-making. It presents the analyses of instances of decision-making, which relied on the double stimulation method as outlined in the methods chapter, unpacking teachers' actions in terms of their motive-orientations and their use of artefacts. The chapter presents examples similar to the one given in the introduction chapter, in which the mathematics teacher Richard decided to interrupt his students' independent work in order to provide supplementary explanation. On the basis of the unpacking of decision-making instances, this analysis seeks to conceptualise and describe the function of the external supports in the teachers' enactment of decisions. Building on the basic theoretical model discussed in chapter three and the corresponding analytical procedures outlined in chapter four, the present chapter thereby addresses research question one directly: *What role does schoolteachers' use of external supports play in their enactment of in-the-moment decision-making?*

In line with the theory development aim of the project, the forming of concepts was a key part of the analysis. Concepts were developed, challenged and refined throughout the analysis of the cases. The concepts which enabled the description of the case teachers' use of external supports are hence important results of the data analysis along with the case descriptions themselves. This chapter starts by presenting the developed concepts, before moving on to the case analyses.

6.1 Conceptual Developments for Explicating the Role of External Supports

The following example from the history teacher Brian's classroom provides an illustrative backdrop for describing the concepts which arose in dealing with research question one; concepts which enabled the case analyses that will be presented in the second part of this chapter. In this example, Brian found that his students did not understand the rules of a board game that he wanted them to play. His motive-orientation towards having the students play the board game was thus challenged. The board game was about the justice system in Saxon England. Brian had not used this game before, but had decided that he wanted to try it out in this lesson. It was made out of paper photocopies, which Brian had asked the students to cut out to produce the different pieces for the game. This instance of in-the-moment decision-making unfolded, first, through Brian's attempt to enable the students to play the game and, second, by moving on to a different task instead.

Brian's first move involved the use of a string of artefacts to improve and assess students' understanding of the procedures of the board game task. Brian clarified expectations about the students' behaviour by saying: "I am aware that this lesson is a little different from normal, but expectations of behaviour are the same." He subsequently targeted the procedures of the task by briefly describing the game verbally. Moreover, he used the written instruction sheet that came along with game, saying that the students should take the sheet and follow the instructions.

Walking around the classroom, Brian assessed students' understanding of the task procedures by asking a particular group of students: "Do you know what you are doing?" With this group, he talked through one round of the board game, using both verbal artefacts and the paper pieces that made up the game. He then went to another

group of students, where he again used a verbal artefact to assess task procedures, asking the students whether they had written down the outcome of the game. He then specified the procedures by saying that they needed to write down the outcomes.

After his interactions with the groups, Brian made a different move, in which another string of artefacts was used to quickly replace the board game task with an independent writing task. Brian's use of artefacts shifted away from his patient attempt to specify in detail the task procedures of how to play the game. In his moving to a new task, and away from the problematic board game task, Brian's use of artefacts shifted towards quickly specifying and enforcing clear and univocal task goals and task procedures. Brian's swift use of artefacts is listed chronologically below in Table 13. The first column in Table 13 lists the artefacts he used. The second column specifies the interpretation of the role of each of the artefacts in Brian's replacement of the problematic board game task. The concepts which focused the analysis on the redesign of student tasks will be elaborated below, after the presentation of the example.

Table 13: Brian's Rapid Specification and Justification of New Task Procedures and Task Goal

Artefacts used by Brian	**Function of artefact in Brian's redesign of the student task**
Verbal artefact: "3,2,1" (counting down)	Specification of task **procedures**, communicating that students should be quiet and attend to what he is saying and doing (Brian often used the counting down from three in this way).
Physical artefact and sound: Reception bell and sound of bell ringing	Specification of the task **procedures**, communicating that students should be quiet and attend to what he is saying and doing (Brian often used a reception bell in this way).
Verbal artefact: "Much better"	Specification of the task **procedures**, communicating that it is much better that the students are now quiet.
Verbal artefact: "You should now have had a go" (a go at playing the board game)	Specification of the **goal** of previous board game task, communicating that the goal has been fulfilled.

Sound: "Shush!" (hushing students when one student says: "No")	Specification of the **goal** of previous board game task, communicating that the goal has been fulfilled despite one student's objection that it was not.
Verbal artefact: Brian says that the students should use the "information" from the game and from other places.	Specification of the task **procedures**, communicating which information the students should use.
Written language: PowerPoint slide projected onto the board which reads 'Plenary question' and then a question about systems of crime and punishment. The slide also has a box with sentences describing a 'good answer', a 'great answer' and a 'superb answer' respectively.	Specification of the task **goal**, communicating that the goal is to answer the question written on the slide, and elaborating the goal further by specifying three different types of answers that are acceptable products of the task.
Verbal language: Brian says: Using the information, "how different is the system of crime and punishment in Saxon England?"	Specification of the task **procedures** ("Using the information"), communicating which information the students should use. Specification of the task **goal**, communicating that the goal is to answer the question written on the slide.
Verbal language: "Any questions?" (No questions asked by students)	Assessment of the need for specification of the task **goal** or **procedures**.
Verbal language: "You've had a whole lesson of play, now it is time to work"	Justification of the task **procedures** ("You've had a whole lesson of play"). Specification of the task **procedures** ("Now it is time to work").
Verbal language: "Do we know what we are doing?" (One student says "yes").	Assessing the need for specification of task **procedures**.
Verbal language: "Then do it"	Specification of the task **procedures**, communicating that the students should hurry up and get started.

Brian used the artefacts outlined in Table 13 to efficiently enact his decision to move on to a new task, in which the students' lack of understanding of the board game was no longer problematic. As evident from the interpretation in Table 13 above, Brian's use of artefacts in this second move was dominated by artefacts targeting the procedures of the student task. He also targeted the task goal, specifying that the goal of

the previous board game task that had been met (having a "go" at the board game), and setting out a goal for the new task using a PowerPoint slide. Furthermore, his assessment of needs for further specification of task procedures ("Do we know what we are doing?") was quickly followed up with an enforcement of the procedures, which he did not specify in further detail.

Tools for redesigning problematic student tasks

The interpretation of the example above was enabled by a set of conceptual insights which brought a particular perspective to the example of Brian's in-the-moment decision-making. This perspective foregrounds the role of artefact use in redesigning problematic student tasks, describing the external supports as tools for reconfiguring tasks that the teacher found problematic or otherwise dissatisfactory. The noticing of the importance of student tasks resulted from a series of conceptual insights that arose from working with the data.

The basic conceptual model and the analytical procedures made it possible to interpret and formulate which motive-orientations that became problematic for the teachers during their in-the-moment decision-making. Looking across the teachers and the different instances of decision-making, it became visible that the decisions they enacted sought to either incorporate or make obsolete motive-orientations that initial activities did not cater to. Both of these options are illustrated in the example above: Brian first tried to reconfigure the board game task to enable students to play; he then left behind the motive-orientation towards the students playing the game, introducing instead a new task where that was no longer relevant.

The analytical attention to student tasks was motivated by the observation that, across the five case teachers, the vast majority of the motive-orientations that became

challenging for them were about the students and concerned their actions. Accordingly, the case teachers' pursuit of those challenging motive-orientations unfolded as attempts to reconfigure the activities of the students. Furthermore, even in examples where teachers' motive-orientations did not concern students directly (for example when a teacher wanted to be funny) the teachers' incorporation of such motive-orientations still unfolded as attempts to reconfigure students' participation (for example by engaging a group of students in conversation to make a joke).

Drawing on readings of the cultural-historical literature, the distinction between implicit and explicit artefact mediation aided a more detailed explication of the role of artefacts in reconfigurations of student activities. Explicit mediation is defined as the intentional introduction of means into unfolding activity, where the intention is to steer that activity (Wertsch, 2007). As Wertsch points out, explicit mediation often takes place when one person attempts to guide and influence the activities of others, for instance when a teacher intentionally introduces various means to guide what students are doing. In the case of implicit mediation, on the other hand, means are 'not purposefully introduced into human action, and they do not initially emerge for the purpose of organizing it' (Wertsch, 2007, p. 181). The distinction helped to conceptually clarify that the case teachers used artefacts for explicit mediation of students' participation in classroom activities.

Another distinction from the cultural-historical literature helped to draw attention to the role of student tasks. As in the example above, the classroom activities that the teachers sought to engage the students in underwent marked shifts, and these shifts were often important to the teachers' resolutions to challenging teaching situations. Conceptualisation of this initially unexpected feature of the data was assisted by the idea that there can be multiple leading activities within a single situation, and that

the relative dominance between activities often shifts as situations unfolds (Daniels, 2008; Griffin & Cole, 1984). For example, as illustrated above, Brian's use of artefacts enabled him to replace the leading activity of the board game with a different leading activity which centred around the question on his PowerPoint slide.

Having noticed shifts in dominance between different leading activities, the exploration progressed by enquiring into what type of activities the lessons were composed of, when seen from the perspective of the teachers. As in the example above, and as will become apparent in the later descriptions of each of the case teachers' decision-making, the focus on student tasks helped specify how teachers' resolutions to challenging teaching situations unfolded.

The attention to student tasks was based on Doyle's ecological perspective on classrooms (Doyle, 1977, 1983, 2006; Doyle & Carter, 1984). The specific focus on classrooms in Doyle's ecological research offers insights specifically about the settings in which teaching is accomplished. At the same time, the ecological perspective is compatible with cultural-historical research traditions. As Doyle (2006, p. 119) notes, the two perspectives share 'a fundamental presumption that human consciousness exists in and grows out of engaging in problem-directed action with materials and in settings whose meanings are culturally and historically situated'. In Doyle's ecological account of teaching, the notion of student tasks is used to highlight a pivotal organising principle for the activities that make up teaching: 'The term "task" is used to designate the situational structures that organize and direct thought and action' (Doyle & Carter, 1984, p. 130). Building on this overall notion, teaching can be understood as the engagement of students in tasks (Thompson, 2015).

Following Doyle's definition, a student task is made up of three main components: product requirements (a *goal*); operations for generating the product

(*procedures*); and resources available for creating the product (*resources*) (Doyle, 1983; Doyle & Carter, 1984). The data analysis made clear that artefacts played various roles in the teachers' enactment of in-the-moment decisions. The conceptual breaking down of student tasks into goals, procedures and resources was helpful in accounting for the varying ways in which the teachers were found to use artefacts to influence the participation of their students. The three short examples below illustrate the kind of differences in artefact use that required such conceptual refinements.

In the first example, the science teacher Michael wanted to move on to an experiment on the falling speed of folded paper helicopters. The paper helicopters were used as models for how some plants spread their seeds. Michael wanted to get the task started quickly after he had just sent out two students due to poor behaviour:

> 'Michael: I want you to begin to think, how can we change the speed? Michael is writing on the board: Seed practical. Aim: Investigate factors effecting...' (Michael, observation)

In the second example, the history teacher Brian made an attempt to tailor a planned information analysis task to fit the "mood" of his students:

> 'Brian says that there are two ways "we can do this." Brian asks whether the students want to do the problems in the groups or "move around and speak to one another." Brian asks for hands on the first option. Nine students put up their hands, including all five of the five-girl group. Brian asks about the second option. No students have their hands up. Brian waits a little bit looking around the room. Brian: Okay. Brian asks the students to move the information slips around room (i.e. so they get a

> new problem to work on without having to move).' (Brian, observation)

In the third example, Isabel wanted the students in her Spanish class to be able to produce previously learned vocabulary without the help of a PowerPoint slide:

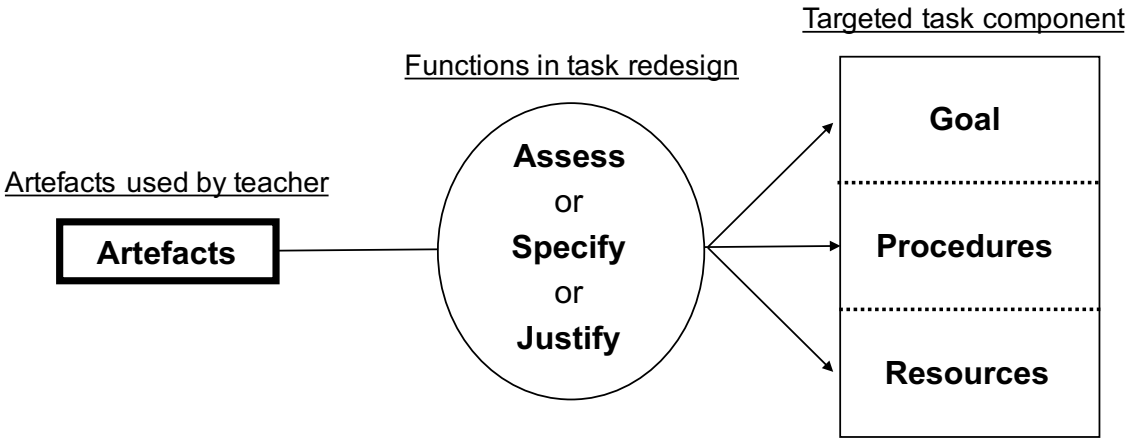
> 'The students are standing in two rows from back to front of the classroom, each pair facing one another. Isabel is at the computer. Isabel: I am just getting rid of the words (i.e. on the slide).' (Isabel, observation)

The artefacts that Brian, Michael and Isabel used in the three examples above differ in terms of the role they played in the teachers' redesign of the respective student tasks. A distinction between these three uses of artefacts can be made by drawing on Doyle's above-mentioned distinction between task goals, task procedures and task resources (Doyle & Carter, 1984). In the example above, Michael used a written artefact (slide reading: 'Seed practical. Aim: Investigate factors effecting…') to target a task goal. Brian used both verbal and gestural artefacts to target task procedures (outlining possible options and relying on a show of hands). Lastly, Isabel used the computer and a verbal artefact to change the availability of task resources (removing the Spanish words that were shown on a PowerPoint slide).

Using the distinction between task goals, procedures and resources, the visual model in Figure 3 below outlines the different functions of artefact use that were identified across the five case teachers' in-the-moment decision-making. While the model marks out the potential functions of single artefacts, the interpretation of those functions relies on rich information about the context of the artefact use. Accordingly, when using this model to categorise the function of an artefact, the function of the artefact should not be seen as inherent to the artefact itself. Rather, the model describes

the role that the artefact gained by being used in the unfolding of a particular instance of decision-making.

Figure 3: Function of Artefacts as Means for In-the-Moment Redesign of Student Tasks



The right-hand side of the model in Figure 3 specifies whether the artefact was used to target the goal, the procedures or the resources of a student task. The left-hand side of the model shows the artefacts that are used by the teacher. The middle part of the model makes a further distinction, differentiating between three ways teachers used artefacts to target task components: did they use the artefact to assess, specify or justify the task component? This broad distinction, which is detailed below, together with the differentiation between goals, procedures and resources, enabled consistent descriptions of the functions of artefact use across the five case teachers, as will become apparent in the case analyses presented in the latter part of this chapter.

The three examples above included artefacts by means of which the teachers were able to *specify* task goals, procedures and resources respectively. For instance, Michael specified the task goal by using writing on the whiteboard. In the second example, Brian specified the procedures of the student tasks, after the show of hands, by

asking the students to move the information slips around room. In the third example, Isabel specified the resources available to the students, taking away a slide that otherwise gave away relevant Spanish vocabulary.

In some of their in-the-moment decision-making, the case teachers also used artefacts to *assess* which goals, procedures and resources that were needed. In the example above, Brian used both verbal questions (outlining two options for how to progress with the task) and gestures (the students' show of hands) to assess task procedures. With these artefacts, he was able to assess whether he should let the task follow the procedures he had planned (students moving around the room) or whether he should change the procedures (letting students stay in their seats and have information sheets move between them).

Justification captures artefact use with which the case teachers sought to provide students with rationales for task goals, procedures or resources. When used in this way, artefacts functioned as means for enforcing or motivating students to attend to a specific task goal, procedure or resource. For example, in a decision-making instance that was *not* mentioned above, the English teacher Emma justified a particular goal while her students were preparing group presentations of poems. She had just specified the task goal using a slide with 'success criteria' and the verbal artefact "Can I remind you that the questions are the most important?" She then used another verbal artefact, this time in order to justify the task goal that she had just specified, adding the rationale that she would be "much more impressed with a group that can analyse the poem than act it out."

The following section presents the case teachers' use of artefacts during in-the-moment decision-making. As already mentioned, the cases and the concepts presented above were developed through a two-way process in the analysis. The concepts were

developed as attempts to capture and systematically account for similarities and differences between the teachers' use of external supports, refining concepts whenever their premises were violated by examples from the data. At the same time, the concepts allowed a consistent way to notice and describe the function of the teachers' use of artefacts during in-the-moment decision-making. The concepts have been presented and illustrated above in order to make it easier to follow the analysis. The adequacy and precision of these concepts, however, needs to be judged on the basis of the case descriptions they enabled and whether the perspective brought out the role that external supports played in the case teachers' enactment of in-the-moment decision-making.

6.2 Analysis of the Five Case Teachers

Brian

In his in-the-moment decision-making, Brian first and foremost used artefacts to simplify goals and procedures. The artefacts he used gave him a way to specify clearly stated task procedures and goals. This was done especially by relying on PowerPoint slides that he had prepared. The other artefacts he used were mostly employed in order to repeat or enforce goals and procedures, not to specify goals and procedures in further detail. Even when assessing which procedures were needed, this assessment was done by outlining clear options.

Brian was, as described in the previous chapter, focused on realising the tasks he had planned for his students. He was, however, experiencing challenges in relation to his students' behaviour and the timings of tasks, which he himself pointed out and recognised. Both of these problems sometimes made it difficult for him to realise the tasks he had planned. The examples below show the artefacts he used to resolve such

logistic challenges. The examples thereby show the kind of artefacts that Brian used in his in-the-moment decision-making to simplify, repeat and enforce student task goals and procedures.

Brian's use of PowerPoint slides provided a way for him to quickly specify task goals and procedures. For instance, in one example, running out of time towards the end of a lesson, Brian was able to turn a planned extended plenary discussion task into a short group discussion task by quickly putting on a slide. In this example, Brian had just ended a group task by explaining about William the Conqueror, writing key points in a table on the whiteboard. Just after making a reminder about student behaviour, Brian put on a slide to quickly move on to the next task:

> 'Brian: "I am quite happy to rearrange you so we don't have these interruptions." Brian has put on a slide, which says "Plenary" and has the title "William easily became King of England". The slide also has a description of the task in the students are asked what they think about the statement. Brian: "There is a success criterion on the board." Brian is referring to the box on the slide, describing a 'good', 'great' and 'superb' answer. Brian is walking around the classroom. Student are now not talking. Brian asks one student: "Can you see?" He then says: "Have a go and answer this question."' (Brian, observation)

In the above example, Brian did not have time for the extended plenary discussion task he had planned. As part of resolving this challenge, Brian used the question and the "success criterion" on his slide to quickly specify the goal of a new and short version of the planned task. The verbal artefacts he used to target the goal of the task referred back

to the written text on the slide ("There is a success criterion on the board" and "Have a go and answer this question."). Brian's verbal assessment of one student's awareness of the task goal ("Can you see") also pointed back to the goal specification on the PowerPoint slide without specifying further the task goal nor the procedures or resources.

The central role of slides for the specification of task goals was also evident when a slide was missing. Having moved the lesson to the bookable computer room, Brian was not able to open and display a slide he had prepared. The missing slide that Brian had prepared contained the answers to ten questions. The students had been asked to answer these ten questions by searching for information on the internet using the computers. Brian first decided to postpone going through the answers to another lesson. However, after a few more minutes of students sitting at the computers, Brian found a way to modify the task so that it incorporated the logistic challenge of the missing slide.

Using a slide with the ten questions (but without the answers), Brian went through the questions one by one taking students' answers. Remembering the answers, Brian used questions to elicit students' answers and verbal explanations, confirming and helping students arrive at correct answers. The use of verbal artefacts, instead of the written language and visual depictions on a slide, became a way for Brian to specify the goal of the task, the goal being the production of answers to the ten questions. Despite the detailed specification of the task goal which Brian was able to achieve by using verbal artefacts, in hindsight Brian would still have preferred to specify the task goal by using a slide:

> "It would have just been a bit easier I suppose to kind of run through the answers with them as they, for the weaker ones, it would have been a visual as well. 'Cause we went through

> verbally, but I'd prefer to, because there are some students in there that are quite weak, to have that visual and answer there as well, just because it reinforces the information." (Brian, interview)

Emma

As she explained, and as evident from her lessons, the newly qualified English teacher Emma did not want to interrupt students when they were working well on tasks. As described in the previous chapter, Emma was well-organised and she often had more tasks prepared than time would allow. She was very attentive to students' feeling and attitudes and showed a genuine interest in what the students were bringing up and able to do in her lessons. However, these orientations, along with her ambitious lesson plans, meant that tasks often continued for longer than she wanted them to. That created the need for in-the-moment decisions about how to speed up the students without interrupting them. It also created challenges when the ways students participated in tasks differed from what she had anticipated in her planning.

One student presentation task, in which students were not attending to the task goals that Emma had intended, provides an example of the way she used a number of artefacts to change student tasks without interrupting the flow of the students' work. The example was mentioned briefly in the beginning of this chapter to illustrate how the teachers sometimes used artefacts to justify task components. Reflecting on this specific lesson, Emma highlighted the challenges of keeping the students "focused instead of just wanting to be very creative." Emma sought to draw students' attention to the intended task goal: "I had to keep reminding them that they had to mention techniques and structure and language and they can get carried away with making a show."

To incorporate her motive-orientation towards having her students analyse the poems in detail, she made two task redesign moves. In the first redesign move, during the students' preparation of the poem presentations, Emma used verbal artefacts and a slide to modify the task goal. Emma was moving between student groups, asking questions about the poems they had been given. By doing so, she drew attention to the importance of analysing the poems. These verbal questions also gave her a way to assess whether students were progressing on the task goal of preparing presentations that focused on detailed analysis of the poems. After moving around talking to student groups, Emma specified the task goal by putting on a slide with six written questions for the students to answer in their preparation of the presentations (e.g. "What do you think the poem is about?" and "What is the tone?").

Emma then addressed the whole class: "Can I remind you that the questions are the most important." As mentioned earlier in this chapter, she followed up this specification with a justification of the task goal, saying that she would be "much more impressed with a group that can analyse the poem than act it out." Through verbal and written reminders as well as the verbal justification of the task goal, Emma found ways to try to draw the students' participation in the task towards a focus on poem analysis. Apart from her commenting on their progress on the task, she was letting groups progress uninterrupted with their preparation of more entertaining parts of presentations that did not seem to relate directly to poetry analysis, for example one group's preparation of a catchy intro and outro robot dance.

During the same lesson, Emma made a second task redesign move during the student presentations. Again, she attempted to make students attend to the goal of analysing the poems in detail, however, by trying to do so without interrupting the flow of their work. Firstly, she put on a slide with six success criteria, all of them relating to

the analysis of their poems. Putting on this slide, she said that those students that were watching presentations should use the success criteria to evaluate how the presenting group was doing. She thereby sought to make these criteria specify the task goal. However, the first group of presenters made Emma change back to the previous slide because they said they needed the questions written on it.

Subsequently, also during the students' presentations, Emma instead turned to verbal artefacts in order to modify the task goal. She did so by posing questions to the presenting groups, thereby expanding their analysis of the poems by making their answers part of their presentations. She used questions like: "What does this suggest about the speaker?" She also targeted task goals by praising one presentation for being "very thorough" and by applauding this particular presentation joined by half of the class clapping. Lastly, towards the end of the lesson, Emma attempted to modify the task goal by verbally inviting the students to evaluate the presentations in relation to the success criteria on the slide.

Targeting task goals was also central in other examples of Emma's in-the-moment decision-making where she dealt with logistical challenges of time limitations. Also when faced with the problem of tasks taking too much time, Emma was reluctant to break off from students' flow of work. One of the ways that Emma resolved such situations included having specific students share the work they had produced. In one example, Emma did not stop the students in their independent writing, although she was faced with time-pressures that challenged the task. Instead of interrupting the students' writing to allow time for the peer-assessment she had planned, she resolved the situation by relying on exemplary student work as a quick way of giving feedback on the writing task:

> "Then, once they'd written their paragraph, I was going to get them to peer assess, so to read each other's, what they did well and what they could do to improve, but time meant that we couldn't, so instead I thought it would be good to hear some of them." (Emma, interview)

In this example, lack of time came in the way of Emma's plans to have her students peer-assess the paragraphs they had produced. She was, however, able to redesign the task to speed it up. Instead of peer-assessment in pairs, Emma specified the task goal by letting particular students read out their paragraphs. In this situation, the students' written paragraphs thereby became important artefacts which she used to target the task goal. Using exemplary student work, Emma found a quick way to specify the task goal in detail: "We got to all hear five really good examples so it's good modelling for them. They got to hear exactly how it's done."

In another example, Emma used a particular group of verbal artefact for her balancing between wanting to speed up tasks and avoiding interruptions to the students' engagement with tasks. Emma used a series of verbal artefacts that revolved around what she jokingly called "teacher minutes":

> "You will have noticed, we were joking about a teacher minute and a normal minute, so I might say for a task, there will be two minutes and if I notice that when the two minutes [have gone] that everyone is still really engaged with it, I am not going to stop it, because [of the] two minutes. I'll normally just keep it going or say I am going to give you another minute now. So I was debating times and wondering what we'd actually manage." (Emma, interview)

In both of the examples below, Emma specified task procedures by announcing the amount of time left for student tasks. However, in both examples, she waited longer that she had announced before ending the tasks. In the first example, she justified this discrepancy in a humorous tone with the notion of "teacher minutes":

> 'Emma: One more minute. Emma says (smiling and saying to the students at the line of tables in the front): Teacher minutes. One girl asks about it (i.e. about 'teacher minutes'). Emma says: Teacher minutes are about 90 seconds.' (Emma, observation)

In a different instance from that same lesson, the use of verbal indications of minutes was again Emma's main tool in her attempt to speed up the student tasks:

> 'Emma says: Two minutes. Just after, she says: Seriously (as in saying: these are two real minutes). A student in the front says: Twenty minutes, guys! Emma looks at the boy. Emma stands next to one student. Seven students are talking, voices in the room are getting loud. Emma: Shush (hushing), I take it you are all finished. One student says: No! Emma: One more minute. One student comments. Emma says: Real minute.' (Emma, observation)

As exemplified by the quote above, Emma also used verbal assessment and justification on task goals in order to hurry up tasks and she did so in ways that did not require the students to divert from what they were doing. With these verbal comments, she was letting students know that their time for writing was coming to an end. For instance, in the above excerpt, she attempted to hurry up the students by saying: "I take it you are all finished." Another example was when she, earlier in that same lesson, was

letting the students know that she could "not wait to see" the results of what they were doing.

Modifying which resources students had at their disposal during tasks also became a way for Emma to speed up some of the time-pressured tasks, minimising at the same time her interruptions of students' engagement with those tasks. In one example, Emma was surprised by how long the students took to complete the task. It was a revision task where students were going over material they had previously worked with. The importance of the task was evident from her justification of its goal, in which she was pointing out to the students that, if they could not do this task, they would struggle in the upcoming assessment. Emma had asked students to write down how representational devices in a film had been used to represent teenagers. After approximately five minutes of students working independently, Emma used the following verbal artefacts and written notes in students' notebooks to make resources available to the students, offering a way for the students to speed up their work on the revision task:

1. Emma said: Think about camera angle and shot.
   [Specifying the task **resources**]
2. Emma said: You have written down in your book all of the presentational devices (i.e. written them in an earlier lesson).
   [Specifying the task **resources**]
3. Emma said: "How are the (mentioning representational devices) used in this film?" [Specifying the task **resources**]

Michael

In his in-the-moment decision-making, the science teacher Michael's use of artefacts was swift and responsive. He used many artefacts and the artefacts he used followed one another quickly. As described in the previous chapter, it was important to Michael that his lessons progressed at a fast pace. This was the case when he was demonstrating ideas, when students were working independently or in groups, when he was making jokes and when he was following up on problematic student behaviour with immediate consequences. Michael did not wait to employ artefacts when he saw the need to redesign tasks. This was evident from the quick adjustments he made to tasks when there were goals or procedures he had not been able to settle in his planning. It was also evident when he saw the need to improvise and build up entire student tasks that he had not planned to include.

Two examples illustrate Michael's use of artefacts for making quick adjustments to tasks. In the first of those examples, Michael had asked the students to swap some finished homework with the person next to them. While Michael was going through the correct answers, the students peer-marked each other's homework, giving each other points for correct answers. A brief moment of uncertainty about how to proceed arose when Michael reached a question on which students were able to get the right answer in multiple ways, including through an incorrect way of doing the calculations. Wanting to reward correct calculations, Michael used the following verbal artefact to quickly redesign the procedures of the peer-making task: "Give them a bonus point if they converted to… (describing the correct calculation)." Michael had not planned this specific aspect of the task procedures. Using the verbal artefact, however, enabled him to adjust the peer-marking task to accommodate the challenge posed by that one "irritating" question.

In the second example of quick adjustments, in-the-moment decision-making was needed from the very beginning of the lesson. Michael was unsure whether he had previously done a task with this group of students. It turned out that he had talked about the task with two of the students during the morning registration session two hours earlier. That morning he had a PowerPoint slide on the board describing the task because he needed it for his first lesson. This sparked conversation about the slide with two students that were thereby introduced to the tasks two hours before they were meant to work on it. Michael had chosen to reuse the same slide and task, but he now had to find a way to resolve the challenge of wanting to teach students new material. In this example, Michael quickly assessed and adjusted the task goal and procedures by employing a number of verbal artefacts. He did so by using the artefacts outlined below:

1. Michael said: I think it is a new question for you (referring to question written on the slide). [Justifying task **goal**]
2. Michael said: Try it (i.e. the question on the board). [Specifying the task **goal**]
3. Michael said: I don't think I have taught you that. [Justifying the task **goal**]
4. Michael asked one student whether he has taught them that. [Assessing the task **goal**]
5. (Five minutes later, while taking answers from the students) Michael said: If you are an (saying the name of his tutor group with whom Michael did the morning registration), I am not going to take an answer... [Specifying the task **procedures**]

6. Michael continued by saying: ...because I know that we talked about it (the two boys with their hands up, take them down). [Justifying the task **procedures**]

In the examples above, Michael was able to adjust student tasks by quickly employing verbal artefacts. He was thereby able to incorporate into those tasks unanticipated challenges that he had not foreseen in his planning. In a third example, however, Michael's swift and responsive use of artefacts became particularly evident because his in-the-moment decision-making involved not only one, but four successive redesign moves. These four successive task redesign moves are outlined below in Table 14. This example was used in the methods chapter to illustrate the analytical procedures and the full analytical table in the appendices contains the analysis of this example (see p. 307).

In this example, it was also a 'starter' task that was challenged in the beginning of the lesson. Michael had intended for the 'starter' task to introduce the topic of the lesson to the students and to "capture their imagination", which he, upon reflection in the post-lesson interview, thought he "failed" to do. As he also described in the post-lesson interview, his planning had been limited for that specific 'starter' task as well as for the subsequent experiment task:

> "Earlier today I got out a post-it note and decided that I'd use seeds to introduce it [the experiment], so I had a few pictures for them to look at and ehh, and I knew that I'd. I wrote down that I wanted to get their aim, for them to consider the variables, write a prediction and then be ready to start the investigation next lesson." (Michael, interview)

The 'starter' task was challenged as Michael saw the need for correcting students' behaviour. As this need was not met by his initial reminders to the student's about expectations about behaviour, uncertainty arose for Michael about how to proceed. As shown in Table 14, he employed multiple strings of artefacts to realise his swift task redesign. His first redesign move was to modify the 'starter' task to incorporate the logistic challenges of student behaviour, while at the same time guiding students' thinking towards the topic of how plants spread their seeds. His second redesign move was to deal with the issue of student behaviour by sending two students out. His third redesign move was to replace the starter task due to the logistical challenges with student behaviour. Lastly, his fourth redesign move was to guard the new experiment task against the challenges concerning student behaviour. As shown in Table 14, Michael accomplished each of the four redesign moves by means of numerous artefacts, which followed one another at a fast pace.

Table 14: Michael's Artefact Use During Four Successive Task Redesign Moves

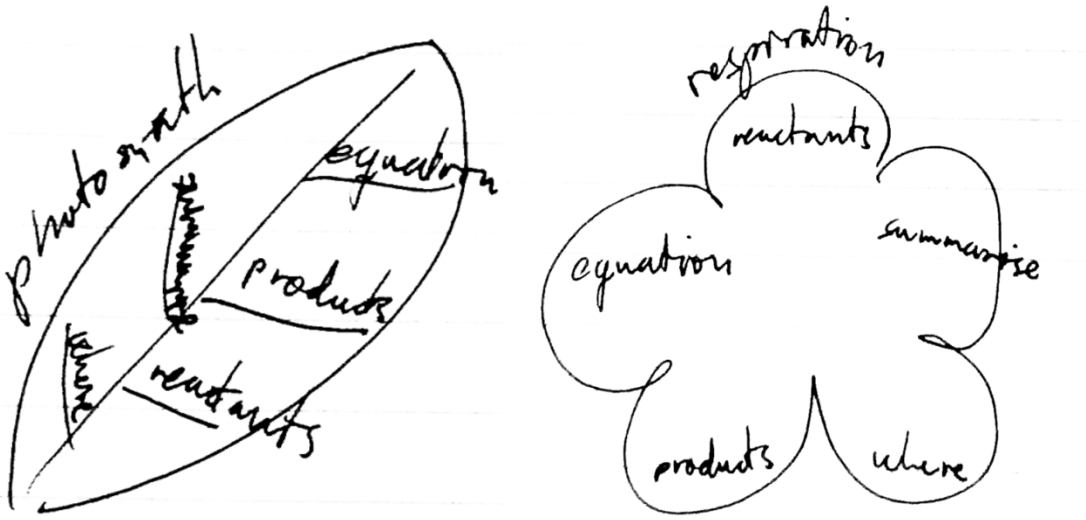
Redesign move	**Motive-orientations**	**Artefacts used by Michael in his redesign moves**
Modify logistics (Specifying the 'starter' task about how plants spread seeds, while at the same time correcting student behaviour)	1) Capture students' imagination and introduce the students to the topic of the lesson. 2) Avoid that students are talking, moving around and making noises.	1) Capture imagination and introduce topic: • Four PowerPoint slides with pictures of deflowered flowers and fruits. • Two verbal invitations for students to guess why he is displaying those pictures. • Two verbal indications that the pictures are about seeds. • Paper helicopter which spins as it falls down. • Three questions about why plants carry their seeds the way they do. • Statement that one student was right in saying that the plants try to get their seeds somewhere else. 2) Avoid talking, moving around and noises: • Four verbal reminders about classroom behaviour. • Gaze (looking around the classroom) • Statement of a general rule about expectations about behaviour in the class. • Instruction that one student needs to move and sit elsewhere in the class.
Deal with issue (Sending two students out due to poor behaviour)	3) Show that disruption and slowing down of the lesson and students' learning are not accepted.	• Two verbal reminders about classroom behaviour. • Instruction that two students need to leave the room. • Statement that Michael can send students out without a "final reminder." • Two warnings to a particular group of students that they could also be sent out. • Statement of a general rule about expectations about behaviour in the class.
Replace task due to logistics (Introduce experiment)	4) Help students prepare experiment.	• Paper helicopter which spins as it falls down. • Chair to stand on. • Question about what they can measure. • Naming 'time' as an "outcome variable". • Verbal statement of the goal of the experiment. • Written statement of the goal of the experiment on the whiteboard.
Task guarding (Introduce experiment while reminding students about correct behaviour)	3) Show that disruption and slowing down of the lesson and students' learning are not accepted. 4) Help students prepare experiment.	3) Show that disruption is not accepted: • Warning that he is prepared to send students out. • "Final reminder". • Statement ruling out the possibility of throwing the paper helicopter from the stairs outside. • Statement that Michael "might allow" some students to use the stairs. 4) Introduce experiment task: • Writing on the board. • Instruction that students should discuss which factors they want to investigate in the experiment.

In other examples, Michael also demonstrated rapid employment of numerous artefacts when he saw the need to improvise and build up student tasks that he had not planned at all. This was evident from an example where Michael was resolving logistic challenges relating to having extra time at the end of a lesson. As already mentioned, it was important to Michael that his lessons progressed at a fast pace. In the example, students were finishing their work on a task which was therefore challenged by Michael's motive-orientation of having something for the students to do. Michael resolved this challenge by moving on to a new task that he had not planned. Using a string of artefacts, he built up a revision task about photosynthesis and respiration in plants. He started by using verbal artefacts ("Okay, can I pause you please" and asking students to put down their pens) and a gesture (raising his hand) to stop students from working on the previous task. He then justified and specified the goal of the next task with the following verbal artefacts:

1. Michael: "This is a revision lesson."
2. Michael said that they were going over stuff that they had been working on before.
3. Michael: "Homework is revising for the test on Monday."

Subsequently, Michael quickly drew two visual depictions on the whiteboard to which he added writing (see Figure 4 below), thereby specifying the task goal.

Figure 4: Visual Depictions with Writing that Michael Created for an Unplanned Revision Task



(Michael, observation)

Michael specified the procedures of the revision task by asking the students to draw and write similar leafs and flowers in their notebooks. Several times, he told the students to use half a page for each drawing. He also justified the task goal by saying: "This is like a note-taking technique." Having started the task in this way, Michael continued it by means of a number of additional verbal artefacts. They included the following:

1. Michael said that he would be coming around.
2. Michael explained, for instance, what the students should write outside the drawn flower.
3. Michael explained that respiration takes place in all cells and not only in flowers.
4. Michael said, among other things, that the students should not write 'equation' but write the actual equation.

Isabel

Similar to Michael, the language teacher Isabel enacted her in-the-moment decisions through making swift adjustments. She employed artefacts quickly to modify the procedures of student tasks as well as the resources available to her students. These swift adjustments enabled flexible redesign of the many short tasks that her lessons tended to comprise. While Michael, as shown above, enacted decisions by employing many artefacts at a fast pace, Isabel achieved her decisions by using relatively few artefacts. The small number of artefacts that she did introduce to redesign resources and procedures allowed her to align student tasks with her overall lesson objectives, compensating for limited planning of the details of student tasks.

Her use of relatively few artefacts for swift adjustments of tasks is exemplified below in Table 15 which contains three examples of her swift modification of student tasks. In the first example, Isabel realised that her students had already done parts of a task in a previous lesson. In the second example, Isabel stopped and restarted a speaking task to help students understand the procedures and provide them with the right resources. In the third example, she improvised procedures to ensure that every student had a speaking partner. In all three examples, Isabel responded quickly as she noticed challenges to the student tasks. She used only very few artefacts to align the problematic student tasks with her overall objectives of the lesson.

Table 15: Examples of Isabel's Swift Adjustments of Resources and Procedures of Student Tasks

Instance of decision-making	**Motive-orientation challenging the student task**	**Artefacts used and their function in the task redesign**
Example 1: Realisation that the students had already done parts of a task in a previous lesson.	Speed up the student task in order to teach effectively.	• Eight letters written on the whiteboard in order to categorise eight words on a projected PowerPoint slide: A, B, C, D, E, F, G, and H [specified task **resources**].
Example 2: Stop and restart of a speaking task to help students understand the procedures and provide them with the right resources.	Have students verbally produce and practise previously learned Spanish vocabulary.	• Computer used in order to get rid of a slide with the words students were supposed to practise verbally [specified task **resources**]. • Verbal statement: I am just getting rid of the words [specified task **resources**]. • Verbal question to the student: Who can explain what we are doing? [assessed task **procedures**]. • One student's explanation of the task procedures (the student says that one asks and then the other answers the weather on the screen) [specified task **procedures**].
Example 3: Improvisation of task procedures to ensure that every student had a speaking partner.	Ensure that every student gets speaking partners.	• Verbal instruction where she says: Let's just do a big circle like we did in year 7 [specified task **procedures**]. • Verbal instruction to one student about where to stand [specified task **procedures**]. • Verbal instruction where she says: "People on the inside are moving. When I say 'cambiad' then inside's moving" [specified task **procedures**]

In the first example in Table 15, the eight letters that Isabel wrote on the whiteboard were the only artefacts that her task redesign involved. The students were meant to match eight Spanish words with eight corresponding pictures also on the slide. As Isabel explained in the post-lesson interview, the students would usually be expected

to write down the vocabulary on the slide as part of completing the task. Realising that the students had previously written down these eight words in their notebooks, the 'starter' task was challenged by Isabel's motive-orientation towards speeding up the task in order to teach effectively. Isabel was, however, able to incorporate this challenging motive-orientation into the task by categorising each of the eight words on the slide with the written artefacts A, B, C, D, E, F, G, and H. Using these written artefacts, she specified new task resources that enabled the students to complete the task faster. Isabel thereby quickly adjusted the student task to compensate for an aspect of the tasks that she had overlooked in her planning.

In the second example in Table 15, Isabel paused while explaining the procedures of a peer-to-peer speaking task. She interrupted her own explanation because the task was challenged by her motive-orientation to have students verbally produce and practise previously learned Spanish vocabulary about the weather. The problem, which Isabel quickly resolved, was that she was still displaying a slide, which contained relevant words about the weather. By specifying the task resources (removing the slide), Isabel was able to align the student task with her motive-orientation towards helping students practise previously learned vocabulary. As outlined in in Table 15, Isabel used the computer and a verbal statement to redesign the task resources, getting rid of the slide that disclosed the words which the students were supposed to produce from memory. Furthermore, she subsequently verbally assessed the need for specification of the task procedures and she used a student's explanation as a way to specify the procedures to all of the students. She thereby found a way to clarify to the task procedures, after having interrupted her own explanation a moment earlier.

In the third example in Table 15, Isabel improvised unplanned task procedures to ensure that every student had a speaking partner. As in the previous two examples,

Isabel redesigned the task while she was introducing it to the students. Also in this third example, she was able to quickly adjust the task by means of only very few artefacts, making the task redesign seem effortless. Although the procedure of having all thirty students stand up and move around was unplanned, she was able to realise this in-the-moment decision by using only the three verbal instructions listed in Table 15. Isabel did not need to draw on artefacts that had been planned specifically for the particular lesson. The three verbal artefacts that she produced on the spot allowed her to achieve flexibility in her redesign of the student tasks. Although she did not herself highlight the means by which she achieved the redesign of the task procedure, she did describe the flexibility that this particular redesign move enabled:

> "I mean, I think again because I hadn't planned it as well as I planned some lesson, I was just gonna gage a bit more their energy and kind of decide from a little bit what they were giving me. I mean things like getting them to stand up and talk, I hadn't actually necessarily planned that well. So that was a more kind of spontaneous, you know, the way we are gonna do was gonna be that way." (Isabel, interview)

Isabel also enacted in-the-moment decisions by introducing entire tasks that she had not planned to include in the lesson. The flexibility illustrated above also extended beyond adjustments. It was also characteristic of her ability to build up entire tasks, allowing her to compensate for limited planning when she saw the need. In one example of that, she incorporated her motive-orientation towards ending the lesson "on a positive note" by introducing a game. As she commented in the post-lesson interview: "The game at the end, was a kind of last minute decision just because it was the last lesson, just wanted to leave on a kind of positive note."

The short game that Isabel introduced at the end of the lesson involved students throwing a teddy bear amongst one another. Whenever Isabel stopped the (Spanish) music, the student holding the teddy bear had to translate an English verb into Spanish using the past tense. Isabel controlled the music on the computer and provided verbs for the students to translate. Isabel quickly built up the game by employing the artefacts outlined below in Table 16.

Table 16: Artefacts Used by Isabel to Build Up an Unplanned Game

Type of artefact	**Artefacts used by Isabel**	**Function of artefact**
Physical object:	Teddy bear.	[specifying task **resources**]
Sounds:	Music.	[specifying task **resources**]
	The school bell.	[specifying task **procedures**]
Verbal artefacts:	Isabel says: "Quick game at the end."	[specifying task **procedures**]
	Isabel says: "I think it is" (in response to a student's question about whether it is a fun game).	[specifying task **goal**]
	Isabel says: "Can you pack up, we are going to play a game, so stay seated."	[specifying task **procedures**]
	Isabel explains that she will say a word, and if you do not know the answer (e.g. 'drank' in Spanish) you are out.	[specifying task **goal** and **procedures**]
	Isabel says that they will pass the teddy bear around while the music plays.	[specifying task **procedures**]
	Isabel says English verbs in past tense, e.g. I went.	[specifying task **goal**]
	Isabel says that one student is out and that she needs to stand up.	[specifying task **goal**, specifying that the student did not produce the goal]
	Isabel says that one student's answer is correct.	[specifying task **goal**, specifying that the student did produce the goal]
	Isabel says: It was (name) (i.e. that had the teddy bear).	[specifying task **procedures**]
	Isabel says that it is just a game.	[justifying the task **procedures**]
	Isabel says: "Saved by the bell" (when the school bell rings while a student is trying to come up with a Spanish translation).	[specifying task **goal**, specifying that the student no longer need to produce the translation of the word]

Similar to the other examples above, Isabel's introduction of the music game involved the use of artefacts which she seemed to have readily available and employ effortlessly. The ease with which the game was introduced was highlighted by Isabel herself in the post-lesson interview:

> "I have a lot of just activities that are in my head that I have done before. I didn't do anything new. I didn't do anything that I haven't done before in a lesson." (Isabel, interview).

Richard

In the lessons observed for this study, Richard's in-the-moment decision-making stood out from that of the other teachers because, instead of focusing primarily on accommodating logistical issues, many of the decisions he made concerned the match between subject matter content and students' abilities. An illustration of this was given in the introduction chapter, in the example where Richard chose to pause students' independent work on a mathematics task because he found that they did not understand some of its core concepts. As shown in the introduction, Richard resolved the issue by assessing the students' challenges with the task and turning to the whiteboard to draw and explain.

Another similar example further illustrates how Richard used artefacts to assess individual students' needs for further specification of task procedures. Also in this example, Richard engaged in in-the-moment decision-making in a response to students' difficulties in understanding calculation procedures. Just after having instructed students to start working on questions on the board, Richard indicated his attention to the difficulty of the task, saying: "Hopefully, I have given you enough scaffolding." Richard then walked around to ten students one-by-one, using the students' written

calculations in their notebooks along with verbal questions, instructions and the gesture of pointing in their notebooks to specify procedures and assess needs for further specification. This use of artefacts gave Richard a way to assess whether he had explained the calculation procedures sufficiently.

Walking among the students as they were working independently and communicating with them individually, Richard noticed "a trick", as he called it, which he had not included in his initial explanation. He therefore addressed the whole class, specifying and justifying this particular aspect of the calculation procedures. He did this by means verbal explanations, writing on the board and verbal instructions to supplement his writing. After his explanation, Richard relied also on a show of hands and questions by means of which he assessed students' progression on the task goal, asking questions about the numbered questions on the board, including: "How many got until [question number] 4 right?" and "Any one got most of what you did right?"

Similar to Michael and Isabel, Richard was able to employ artefacts quickly in his in-the-moment decision-making, seemingly having a lot of artefacts readily available without having prepared these specifically for the lesson. Richard's in-the-moment decision-making, however, differed from that which was observed in Michael and Isabel's lessons, when Richard employed strings of artefacts with the purpose of swiftly adjusting the level of task difficulty.

In the example mentioned above, Richard sought to make it easier for his students to produce the goal of the initial tasks, ensuring that the students understood and were able to carry out every part of the calculation procedures. He did so by following up his assessment of task procedures by diverting from the initial task temporarily. Richard diverted from the initial task to allow for demonstration and explanation in front of the whiteboard. Richard paused the student's independent work

to ensure that all the students knew a particular aspect of the calculation procedures ("a trick"), which he had initially overlooked in his explanation earlier in the lesson. To include this specific subject content matter, Richard built up a short subtask by using the following artefacts:

1. Verbal statement that they missed "a trick" in his previous explanation. [Specification of the **goal** of the subtask]
2. Verbal statement that he had overlooked this but now had noticed it. [Justification of the **goal** of the subtask]
3. Visual depictions on the board in the form of circles and crossing out of a number he previously wrote. [Specification of the **goal** of the subtask, i.e. getting the right number instead of the wrong one]
4. Writing on the board where he added a different number, replacing the one he crossed out. [Specification of the **goal** of the subtask, i.e. the goal of getting this correct number instead]
5. Verbal statement that he "tricked" himself in his initial explanation. [Justification of the **goal** of the subtask]
6. Verbal instruction that the students should put their pens down and look up. [Specification of the **procedures** of the subtask]
7. Verbal statement about the correction on the board: "We need to make sure you get this before we move on." [Justification of the **goal** of the subtask]

8. Verbal instruction: "Show of hands, how many got that?" (I.e. understood why the number on the board needed to be changed). [Assessment of the **goal** of the subtask]
9. Verbal explanation of why the number on the board needed to be changed. [Specification of the **resources** of the subtask, i.e. resources for understanding how to get the correct number]

In the example above, Richard inserted a subtask to explain subject matter content to make it easier for the students to do the initial calculation tasks. In another example of in-the-moment decision-making, however, Richard sought to match subject matter content and his students' abilities by *increasing* difficulty. Responding to the challenge of differentiating an initial task to match the different abilities of his students, Richard introduced and built up a parallel task. In this example, Richard was teaching only eight students, because half of the class was away on a trip. As Richard described in the post-lesson interview, having fewer students in this particular lesson allowed him to "extend" some of the students' thinking and "enrich their experience by getting them to think about their thinking":

> "That lesson in some ways was a luxury to be able to step back and say: Okay let's really talk about the maths, let's really think about what we are doing and why we are doing it. Now I'd always attempted to teach in that way but sometimes ehh with 30 students it is very difficult to get them all engaged in the understanding." (Richard, interview)

The parallel task gave Richard a way to pursue his motive-orientation towards extending some of the students' thinking, while the rest of the students were still

working on the independent task. Richard had started the lesson by putting on a slide with four different questions, covering four different mathematics topics. Having initiated this independent student task, he went on to build up another task. The key artefacts in setting up this parallel task were two chalk blackboards on the side wall of the classroom. On these blackboards, Richard could write questions and he could comment and ask about students' calculations as they were working on the questions on the blackboards.

Richard's introduction of a parallel task required him to specify task goals and procedures in a way that was not usually necessary. Running two student tasks in parallel, Richard employed a number of artefacts to specify who should follow which procedures and goals. By means of this use of artefacts, Richard attempted to single out specific students for the new parallel task. He also sought to clarify who should still be working on the initial independent task. Lastly, he eventually used artefacts to end the initial task, instructing all students to attend to the new task on the chalk blackboards. Richard used the following long string of artefacts, most of them verbal, to achieve the differentiation in students' roles between the two tasks, some of them working independently in their books, while others were working on the parallel task on the blackboards:

1. Assessment and specification of who should take part in the parallel task on the blackboards, i.e. who should follow which **procedures** ("If you think you have any helpful contributions, please go and help yourself to a piece of chalk. Be brave").
2. Verbal specification of **procedures** for the rest of the students (Richard says: If you are not brave, do it on paper).

3. Question to one student about whether he wants to work on the blackboard, i.e. about which **procedures** he wants to follow (It turns out that the boy had his hand up because he wanted to ask for help for his work in his notebook).
4. Physical object given as **resource** for the task on the blackboards (Richard gives chalk to two students that have come up to one of the blackboards).
5. Verbal specification of **procedures** for those not working on the blackboards (Richard says: Those of you that are not so confident, you might want to have a look [i.e. look up at the blackboards] and see if you can follow what they are doing).
6. Assessment of the need to specify task **procedures** (Richard asks a question about why some students are doing nothing).
7. Verbal specification of **procedures** for those not working on the blackboards (Richard says: I didn't say help each other).
8. Verbal specification of **procedures** to two more students that want to work on the second blackboard (Richard says: Why not together, discussing how to do it?).
9. Verbal assessment of the need to specify task **procedures** for one student (Richard asks: [Name of student], what is your contribution, what are you doing?).
10. Verbal comment to specific **procedures** to student who said he was waiting, not knowing what to do (Richard says he should try to work out the questions in his own notebooks).

11. Verbal assessment of students' progression on the **goal** of the independent task in their notebooks (Richard says: Who has done everything they can do on their own, show of hands).
12. Verbal assessment of students' progression on the **goal** of the independent task in their notebooks (Richard says in response to the six hands that have come up: Have you really?).
13. Verbal specification of **procedures** for those students that were working in their notebooks (Referring to the calculations on the blackboards, Richard says: Would you like to spend a couple of minutes to have a look at the solutions?).

6.3 Conclusion

The differences between the case teachers enabled insights into variations in artefact use. While the newly qualified teachers Brian and Emma sometimes struggled to realise their detailed lesson plans, the more experienced teachers Michael and Isabel were able to improvise and adjust tasks without being dependent on detailed planning. The most experienced of the five case teachers, Richard, also had the flexibility to adjust and improvise student tasks. He did so not only to incorporate logistical challenges. Contrary to the four other case teachers, Richard primarily engaged in in-the-moment decision-making about how to match subject matter content with the abilities of his students. However, despite the differences between the challenges that the five teachers were resolving, their in-the-moment enactment of decisions consistently relied on the production and communication of artefacts, by means of which they sought to assess, specify and justify the goals, procedures and resources of student tasks.

In the lessons observed for this study, Brian primarily enacted in-the-moment decisions by using artefacts that simplified goals and procedures of student tasks. He used artefacts that allowed him to repeat and enforce goals and procedures, but without specifying them in more detail. He relied in particular on written artefacts that he had prepared specifically for the given lesson, such as PowerPoint slides. These were used in concert with a number of verbal artefacts to specify and justify procedures and goals when tasks were challenged by limitations of time, by students' "mood" or by students' lack of understanding of how to participate in the tasks Brian had planned.

While Emma, like Brian, was engaging in decision-making relating to the realisation of detailed lesson plans, her artefact use differed from Brian's. Although Emma also relied on artefacts that she had prepared specifically for the given lesson (e.g. slides), she did not want to use these to interrupt student tasks, like Brian did. She instead found ways to reconfigure tasks without interrupting her students. She did so by relying on a varied array of artefacts. To hurry up students, she, for instance, used the verbal artefact of "teacher minutes", indicating remaining time but allowing students to continue for longer. Furthermore, she continuously used verbal artefacts to provide details about task goals, procedures and resources. She thereby left students with much more elaborate specifications of tasks compared to Brian, who mostly attempted to ensure simple and univocal specifications of goals and procedures. Emma elaborated tasks by communicating to the whole class as they were working and by coming around to individual students or groups. She also used students' work, at the end tasks, as a means to quickly specifying task goals.

For Michael and Isabel, their in-the-moment decision-making did not concern challenges of realising detailed plans made specifically for each lesson. Their decision-making dealt with the opposite challenge. Drawing on plans and experience from

previous years of teaching similar lessons, Michael and Isabel often had to redesign tasks to align these with unanticipated logistic challenges. Their swift reconfiguration of student tasks allowed them to compensate for their limited planning of the particularities of these tasks. In many ways, Michael and Isabel did not need the detailed planning, exactly because of the flexibility that their quick adjustments permitted.

Michael was able to compensate for limited planning by using artefacts at a fast pace. Sometimes, his task redesign involved the quick use of only a few artefacts. At other times, he reconfigured problematic tasks through the fast use of long strings of artefacts, including by using strings of artefacts to build up tasks that he had not intended to include. In his brief adjustments, verbal artefacts were the key means for reconfiguring student tasks. When he enacted decisions through more extensive redesign of tasks, Michael relied on a whole range of different artefacts (spoken language, writing, visual depictions, gestures and physical objects), which he was able to quickly orchestrate into responsive redesign moves; strings of artefacts he seemingly had readily available, despite the fact that he had not prepared these artefacts for the particular lessons.

Similar to Michael, Isabel was able to make swift adjustments to tasks by employing only a few artefacts. She did so to modify the resources available to the students or to specify task procedures. She often employed these artefacts already during her introduction of student tasks, seemingly very quickly anticipating needs, which she had not foreseen in her planning, but which were important in order to align tasks with her overall objectives of the lesson. Like Michael, Isabel was able to enact in-the-moment decisions by building up tasks without having planned these. While the newly qualified teachers Brian and Emma relied much more on artefacts prepared specifically for each lesson, Isabel drew on artefacts which she had not prepared for the

specific lesson. Adjustments and the building of new tasks were realised through the swift use of artefacts that were either already available in the room (e.g. a teddy bear) or which Isabel could quickly produce by speaking, writing or using the computer.

As already noted, Richard's artefact use differed from the other four case teachers in important ways. While he also in some examples responded to logistical challenges, he furthermore enacted in-the-moment decisions which concerned the level of difficulty of tasks. In these examples, he realised attempts to match subject matter content and students' abilities by employing a number of artefacts. First of all, he used a large number of artefacts to assess the need for specification of task procedures and task goals, both when addressing the whole class and when coming around to communicate with individual students. Furthermore, he used strings of artefacts to insert subtasks through which he could specify procedures and resources of initial tasks that he saw as too difficult for the students. In building such subtasks, verbal artefacts were supplemented by the flexibility afforded by writing on the classroom whiteboard. Lastly, he used artefacts to introduce parallel tasks whereby he was able to increase task difficulty for some of his students. The creation of parallel tasks to differentiate task difficulty required Richard to rely on a whole string of verbal and physical artefacts by means of which he specified who should follow which procedures and goals.

As evident from the summary above, this findings chapter has demonstrated and conceptualised how the use of external artefacts was instrumental to the five case teachers' enactment of in-the-moment decisions. The chapter has shown that, despite the differences between the teachers, they all relied on artefacts to redesign problematic student tasks. The chapter detailed how the teachers used strings of artefacts to reconfigure the goals, procedures and resources of student tasks, thereby creating ways to incorporate and make obsolete challenging motive-orientations that arose in-the-

moment. This findings chapter has thus provided the first part of an empirical and conceptual argument for the importance of attending to the outward and practical dimensions of teachers' use of external supports during in-the-moment decision-making. The second part of that argument will follow in the next findings chapter, which examines the conditions for producing and communicating artefacts.

The next chapter focuses on the physical and cultural arrangements of teacher decision-making situations, analysing and conceptualising how these have a bearing on the use of external supports. The next chapter builds directly on the findings presented in this chapter, examining the same instances of decision-making, this time, however, focusing on the circumstances that enabled and constrained the teachers' reliance on external supports. The findings from the present chapter and the next chapter will be examined further in chapter eight, which will summarise the findings and discuss their implications.

7 The Case Teachers' Interweaving of Physical and Cultural Circumstances

The previous chapter showed how the case teachers enacted in-the-moment decisions by using artefacts to target and reconfigure student tasks. Those findings made relevant further exploration of the external dimension of in-the-moment teacher decision-making along the lines of artefact mediation: if the use of artefacts is instrumental to the realisation of in-the-moment decisions, the circumstances that shape the use of artefacts are also likely to have a bearing on the decision-making.

The present chapter progresses the analysis by addressing research question two directly: *How do physical and cultural circumstances of teaching situations enable and constrain schoolteachers' use of external supports during in-the-moment decision-making?* As in the previous chapter, the analysis presented in this chapter involved detailed unpacking of examples of decision-making and comparison between the case teachers, resting on the analytical procedures developed from the method of double stimulation. In line with the theory development agenda of the study, the chapter focuses on presenting the concepts that were used to capture the role of physical and cultural circumstances.

The starting points for the analysis of the physical and cultural circumstances were three interrelated ideas which were presented in detail in the theory chapter. The first idea, which was the core of the previous chapter, was the notion that the teachers' actions are mediated and achieved by means of artefacts. The second general assumption was that everyday situations are arranged in certain ways, both materially and socially. Situations like those taking place in a specific classroom are imbued with

different collective meanings and are arranged in ways that have bearings on the unfolding activities. In the theory chapter, this basic idea was emphasised by adopting the concept of activity settings (Hedegaard, 2012a, 2012b), thereby stressing that the teachers' decision-making unfolds in settings that are embedded in institutional practices, that the physical and cultural arrangements of these settings have developed over time and that the particularities of these arrangements become conditions for the teachers' actions.

The third key notion, which is developed further in this chapter, is the attention to situational shaping of artefact mediation (Daniels, 2012a). As described in the theory chapter, the argument for this particular analytic attention has the following structure: if artefact use is important to individual decision-making, and if individual decision-making takes place within activity settings that have specific physical and cultural configurations, then it becomes relevant to examine whether, and in what ways, artefact use is shaped by specific configurations of activity settings.

Building on the findings from the previous chapter, the analysis sought to examine the role of physical and cultural circumstances along the lines of the following questions:

1) What were the circumstances that enabled and constrained the case teachers' *production* of artefacts during in-the-moment decision-making?
2) What were the circumstances that enabled and constrained the case teachers' *communication* of artefacts to students during in-the-moment decision-making?
3) What were the circumstances that enabled and constrained *the utility* of the artefacts for the case teachers when it came to pursuing and satisfying the requirements that the teachers recognised in particular situations?

All three questions are specifications of an overall interest in the ways teaching situations were arranged *prior to* the emergence of a need for in-the-moment decision-making and how such arrangements contributed to and made possible a specific use of artefacts *during* the enactment of decision-making. In other words, seeking to explicate external dimensions of teacher decision-making, the analysis examined each instance from the following perspective: in what ways was the specific teaching situation ready for the teacher's particular use of artefacts?

The chapter shows how the case teachers' use of artefacts during in-the-moment decision-making was enabled and constrained by (1.) the availability of productive means; (2.) the occupation of convenient points for communication; (3.) the students' familiarity with task scripts; and (4.) the reliance on acceptable modes of communication. Each aspect is presented in turn below. A key part of the argument in this chapter, however, is that all four aspects were at play simultaneously. Therefore, the latter part of the chapter will highlight how the case teachers, through their use of artefacts, relied on continuous interweaving of all four aspects.

7.1 Means for Producing Artefacts In-the-Moment

The example below is taken from the same lesson that was mentioned towards the end of the previous chapter, where Richard made use of chalk blackboards on the classroom wall to ensure that all of his students were sufficiently challenged. In this lesson, Richard had postponed what he had initially planned for the lesson because half of the students were unexpectedly away on a field trip. As a consequence, after the students had finished their work in their notebooks and on the blackboards, Richard had to come with up with alternative tasks for his very small class of now only eight students.

Faced with the challenge of finding something for the students to do, Richard had been relying on what he had available, including a PowerPoint slide with mathematics questions that he had originally prepared for a different lesson and the chalk blackboards that he had convinced the school management to have painted on the side walls of his classroom. After the use of the blackboards, Richard's next task redesign move was also built using what he had available in the room:

> 'Richard says to the students (whom are all sitting down): There are some papers around the room with info. Richard explains about metacognition and thinking about thinking and about the questions on these sheets that are put up in the room. The sheets are laminated A3 sheets of which there are three identical ones around the room, one by the classroom door, one in the back left corner where I am sitting and one on the right-hand side wall towards the back of the classroom. The sheets have 5-6 subheadings, under each of which there are 3-5 questions. Each question is a question that students could ask themselves, e.g. "How can I..." (...challenge myself more). Richard: So you can just go and find a question you like. He is referring to the questions on the A3 sheets. Richard asks the students to get up. All students are up from their chairs, and at least three students are down in the back left corner where I am sitting and where one of the A3 sheets is. The students are looking at the sheets. Two or three students in my corner are commenting on them and reading out a question. There are also students by the two other sheets in the other corners of the room. Richard walks down past

where I am sitting and he says to me: We work with the things
we have and make it a rich lesson.' (Richard, observation)

Working with the things the teachers had available was crucial across their in-the-moment decision-making. The importance of availability, and being able to produce artefacts at the right time, became particularly visible when the teachers were missing artefacts that they had expected to be able to use. An example of such surprise was included in the previous chapter to exemplify how the history teacher Brian often made use of PowerPoint slides to specify student tasks. In that example, Brian had moved the class to a computer room. As he was about to go through the answers to the questions that the students had been working on, he discovered that, contrary to his expectations, the slide with the answers was missing. Unable to produce the slide at that specific moment, Brian instead relied on a different group of artefacts that he did have a way to produce. Instead of using the computer and projector to produce the written artefact of the slide, he simply produced the answers verbally, remembering the answers to all ten questions.

The analytical attention to the case teachers' production of artefacts was guided by the conceptualisation of double stimulation detailed in the theory chapter. This focus drew in particular on Valsiner's (2000) emphasis on the ways individuals act *on* and transform their immediate environments to produce artefacts. In the double stimulation situation, when an individual is presented with a first stimulus (a motive-orientation which is difficult to satisfy), the tools for resolving this situation do not need to be available in a ready-for-purpose form. The individual's use of a second stimulus (an artefact that the person uses to settle the situation) is creative in the sense that the person creates these artefacts from what is physically at the person's disposal. The artefacts are not seen as simply present as mediating artefacts independent of the action that uses

them. Instead, the use of artefacts involves manipulation with the physical environment to produce the artefact in-the-moment as a tool for action.

The means that the teachers relied on to produce artefacts during their enactment of in-the-moment decisions varied depending on the artefacts they used. In the example mentioned above, Brian's intended use of a slide required different external means than his verbal run-through of the answers. The production of the slide, in the specific moment where he wanted to use it, required a computer, a projector, a whiteboard and the relevant file (which was unavailable). Brian's verbal presentation of the answers, to which he instead resorted, relied only on his voice. Similarly, in the example above from Richard's lesson, the presence of the laminated A3 sheets on the classroom walls became a means for producing the questions that guided the improvised discussion task.

As will become clear throughout the examples given below, the means for producing artefacts depended on the specific artefacts the teachers used. Taken together, the examples highlight how the case teachers' use of artefacts was enabled and constrained by the productive means they had within reach. The examples illustrate the importance of having available the right productive means at the right time, showing how the teachers relied on having available the external material which was transformed into artefacts as well as the physical devices (for example pens, voice, computers or sheets of paper) with which to create the artefacts.

The examples below also show how the production of some artefacts relied on external means which were available only because of considerable preparation (as in the example of Richard's A3 sheets on the classroom walls), while others were producible through means that required no preparation. Moreover, the examples illustrate how some means offered considerable flexibility for producing artefacts, such as the flexibility enabled by pens and boards for writing and drawing. The presentation below

is organised to give examples of all six groups of artefacts: objects, writing, visual depictions, sounds, gestures and spoken language. Organising the presentation according to the different groups of artefacts should *not*, however, be taken to imply that all artefacts within one group (for example all sounds) were produced by relying on the same means, nor that these productive means were necessarily inherent to the different artefacts. The grouping of the examples is only intended as a way to bring out the general point about the importance of the availability of productive means as an enabling and constraining circumstance for the teachers' enactment of in-the-moment decision-making.

The use of *objects* sometimes required considerable preparation from the teachers. The previous chapter presented an example where Brian was trying to help his students understand a board game that they had not played before. In his attempts to instruct his students about the procedures of the game, the paper pieces (for example paper coins) that made up the game became key tools for going through the rules with a group of boys. Prior to the lesson, Brian had photocopied these pieces and had brought them to his classroom. Earlier during that lesson, before the need to reiterate the rules of the game arose, Brian had asked the students to cut out the pieces from the photocopied sheets, which had led to considerable interaction about how to cut them correctly and how to limit the amount of cut-off paper bits on the floor. While being an obvious condition for getting to play the board game in the first place, the preparation of the paper pieces was also what made them available so that Brian could use them in his explanation of the rules of the game.

While the use of objects rested on them being present in the room and within reach at the right moment, this did not always entail that the teachers had prepared the objects specifically for that lesson, nor for the specific purpose for which they were

used in the teachers' in-the-moment decision-making. In one of such examples, the mathematics teacher Richard made use of the unexpected presence of a ladybird in the classroom. In this example, the ongoing student task was becoming problematic because Richard vacillated between two different motive-orientations. On the one hand, he wanted to provide students with a procedure for calculating a particular type of trigonometry questions. On the other hand, having been away from this group of students for four weeks because an intern had taught the class, Richard wanted the students to recognise him as a fun teacher with personality. As part of pursuing this second motive-orientation, he used the presence of the ladybird (and the book he carried it on) as an opportunity for turning them into artefacts used in his entertainment of the students, a move which at the same time got rid of the distraction caused by the insect:

> 'A student (girl) says out loud: Oh my God! Get rid of it now! Richard walks down there and says: Are you afraid of a little ladybird? There is a ladybird crawling on the boy's book next to her. Richard walks towards the classroom door with the ladybird on the book, while the girl says it is poisonous. Richard is away for twenty seconds. There are four loud noises from outside the classroom door, sounding as if someone is stamping his shoes to the ground or banging a book towards the wall. A student inside the classroom says: I think he is pretending. Richard walks into the classroom with a little smile, looking around the classroom.' (Richard, observation)

Producing *writing* at the right time in the redesign of problematic student tasks often required the text to be present and within reach already prior to the task redesign move. Examples of this included the use of PowerPoint slides, paper slips with text on

them and classroom wall posters. The importance of prior preparation and presence for the production of these written language artefacts was in some cases similar to the above-mentioned circumstances relating to object use. For example, when Richard drew on the A3 wall posters with self-reflective questions about mathematics, the posters had been there on the wall all along, including in previous lessons. In other examples, however, the potential flexibility of writing was evident, especially when teachers used the whiteboard and pen. For example, when Richard wanted to ensure that students had enough to do towards the end of a lesson, he used whiteboard and pen to write out an eight lines long mathematics tasks about going to an Italian restaurant, with questions about what to pay and how much to tip.

Writing was also sometimes written by students before it was turned into an artefact in the teacher's enactment of in-the-moment decisions. One example of this comes from Emma's teaching, and was mentioned in the previous chapter. As part of speeding up her students' work on a task, she drew their attention to notes the students had themselves written in their individual notebooks in an earlier lesson: "You have written down in your book all of the presentational devices." She thereby used the students' own writing in her specification of the resources needed for the task, making it easier for them to analyse how representational devices had been used in a film they had watched.

In terms *visual depictions*, the productive means that went into producing this type of artefacts mirrored the productive means relating to writing. Like with writing, pens and whiteboards enabled flexibility to produce visual depictions when needed. Also similar to writing, visual depictions sometimes had to be prepared and brought into the classroom to become available in the decision-making situation. For example, struggling to capture his students' imagination, Michael relied on PowerPoint slides he

had prepared in order to show pictures of different plants, trying to make the students think about the different ways plants have adapted to spread their seeds.

Generally, PowerPoint slides were the main source of visual depictions used during the teachers' in-the-moment decision-making. They were often the centre of student tasks, as for example, when Isabel had a word-picture matching task revolve around a slide with Spanish vocabulary and related pictures. However, the teachers also made use of visual depictions that had been drawn by the students. For example, Emma found a way to round off a task by having students show the graphs they had been drawing, much like she had in a different lesson asked students to read out written paragraphs.

The case teachers produced and used *sounds* in different ways in their in-the-moment decision-making. Some sounds were produced vocally, offering the teacher considerable flexibility in terms of the timing of the sound. An example of this was the use of the sound "shush" to quiet student, which both of the newly qualified teachers Brian and Emma made use of in their redesign of problematic student tasks. Also the teachers' computers offered flexibility in terms of producing sounds. This was the case in the example mentioned in the previous chapter where Isabel was improvising and building up a music game at the end of the lesson. Isabel found the music (a Spanish pop song) via the internet and also used the computer to pause and restart the music as the game unfolded, asking students who had ended up holding the passed around teddy bear to translate an English verb into Spanish.

One teacher, Brian, had brought to his classroom a specific instrument for making one particular sound: a reception bell. As mentioned in the previous chapter, Brian rung this reception bell as part of his in-the-moment decision-making to quiet the students and get their attention. Compared to the use of voice or the computer to create

sound, this bell was inflexible in the sense that only produced on particular sound, "ding!", and it had required preparation to make the students familiar with its meaning. Brian was continuously working to build up a particular significance around this sound. He often reminded the students that the sound of the bell meant that they should be quiet and listen.

The use of the body to produce *gestures* allowed considerable flexibility in terms of timing. The use of a raised hand, for example in Michael's teaching, was part of catching the students' attention and getting them to listen. In another example from Richard's teaching, Richard used his hands to point out where he wanted the students to stand during a group discussion task. In a third example, this one from Brian's teaching, being able to produce a particular gesture also became central in his in-the-moment decision-making. In this example, the task of finding information on computers in the computer room was challenged by one girl who did not want to give Brian her mobile phone:

> 'Brian stands in front of three girls that sit at the back row of computers. Brian is asking the middle girl to give her phone. Brian is standing on the other side of the table with his one arm stretching forward towards the girl with his hand open. The student sits back in the chair. The two girls on either of her sides are looking at her and Brian. The girl in the middle says something about another teacher that "tells you to put it away." Brian: "No, pass it over." Brian stands there ten seconds without saying anything. He is still stretching one hand forward, his palm facing upwards.' (Brian, observation)

None of the in-the-moment decision-making which was observed in this study was enacted without the use of *spoken language*. Even when other types of artefacts were central to the task redesign, they were accompanied by spoken language, as in the examples of gestures given above, where Brian uses for example "no, pass it over" together with his hand gesture. In the teachers' in-the-moment decision-making, their use of spoken language was characterised by flexibility and speed when compared to the other types of artefacts. The teachers did not need to bring anything to the classroom in order to produce speech during their in-the-moment decision-making (given that they knew what to say). They did not have to ensure that they had anything specific within their reach at the right moment.

Compared to writing and drawing of visual depictions on the board, the production of speech was also considerably faster, which again made timing easier and the task redesign quicker. The example below, which was also highlighted in the previous chapter, illustrates the flexibility and speed of spoken language in the task redesign, showing how Michael resolved challenges to the peer-assessment task that had a question where wrong calculations could still lead students to arrive at the right result:

> 'Michael says about a question that it is "irritating" that calculations are giving the same result, even if one did the calculation in a wrong way. Two students in the back comment on this to one another, the boy smiling and saying something (seemingly having done the calculation in the wrong way but still having arrived at the right answer). Michael says to the students: Give them a bonus point if they converted to (...) (i.e. if the calculation is done in the right way).' (Michael, observation)

Like with writing, visual depictions and gestures, the case teachers also sometimes relied on the students as productive means when using spoken language as artefacts in their task redesign. In those situations, the teachers made use of spoken language that students produced to specify or assess components of a problematic task. An example from Isabel's teaching illustrates the way the case teachers used verbal artefacts that were produced by students. In this example, a Spanish speaking task was complicated by Isabel's need to pause her explanation and change the slide on the computer. As part of redesigning the problematic task, Isabel invited students to produce answers that would help her specify task procedures. As part of clarifying the procedures, Isabel relied on a student to give an explanation:

> 'Isabel: Who can explain what we are doing? A student says that
> one asks and then the other answers the weather on the screen.'
> (Isabel, observation)

This section has, by illustrating the use of objects, writing, visual depictions, sounds, gestures and spoken language, detailed how the accessibility and flexibility of productive means were part of the external circumstances that enabled and constrained the five teachers' use of artefacts during in-the-moment decision-making. As noted earlier, requirements relating to the production of artefacts interwove with other practical considerations. While having the means to produce the artefacts at the right moment was a critical aspect of the teachers' enactment of decisions, the teachers' redesign of problematic tasks furthermore rested on requirements relating to the communication of artefacts to the students. The next three sections focus on physical and cultural circumstances that enabled and constrained the five teachers' communication of artefacts to students, as well as how this communication made artefacts useful tools in the teachers' in-the-moment decision-making.

7.2 Convenient Points to Communicate From

The example below revisits an instance from Emma's teaching in order to illustrate how shifts between whole-class communication and communication with individual students offered different opportunities and constraints for the communication of artefacts during in-the-moment decision-making. In this example, students were not attending to the task goals that Emma had intended. Reflecting on this specific lesson, Emma highlighted the challenges of keeping the students "focused instead of just wanting to be very creative." Emma sought to draw students' attention to the intended task goal: "I had to keep reminding them that they had to mention techniques and structure and language and they can get carried away with making a show."

To incorporate her motive-orientation towards having her students analyse the poems in detail, Emma was moving between student groups, asking questions about the poems they had been given. Moving between the groups allowed her to interact with individual groups. It allowed her to ask questions directly related to the presentations the groups were preparing, attempting to draw their attention to the importance of analysing the poems. It also allowed her to use these questions to assess how the individual groups were progressing on the task goal: preparing presentations that focused on detailed analysis of the poems.

After her questions to the groups, Emma moved to the front of the classroom, thereby shifting to a different point of communication. From up there, she specified the task goal by putting on a slide with six questions for the students to answer in their preparation of the presentations, for example 'What do you think the poem is about?' and 'What is the tone?' Emma then addressed the whole class: "Can I remind you that the questions are the most important." She also followed up this specification with a

justification of the task goal, saying that she would be "much more impressed with a group that can analyse the poem than act it out."

Focusing on differences in points of communication makes visible how Emma's change between communicating with student groups and communicating with the whole-class also involved a change in the artefacts she used. The two different points of communication, being next to student groups and being in front of the classroom, offered different opportunities and limitations for artefact use. In her interaction with the individual groups, she was able to specify the task goal by using students' answers and questions related to the poem and the presentation that the specific group was working on. In her communication with the whole class, she had to keep her instructions more general, emphasising the importance of thorough poem analysis by putting on a slide for everyone to see, and by making general statements about the task goal.

Across the five case teachers, like in the above example from Emma's teaching, the location of the teachers in the classroom during their in-the-moment decision-making offered different physical points from which to communicate with students. The physical location of the teacher, firstly, had a bearing on whether the means for producing artefacts were easily within reach. For example, Emma needed to be at the computer to put a PowerPoint slide. Similarly, the use of students' writing, questions and comments depended on proximity. For example, as a result of moving between students' desks, Richard's attempt to clarify difficult calculation procedures was aided by standing next to a student that was working in her notebook. This location made it convenient for him to use the writing of that student as an artefact for assessing and directing her work on the task, by pointing to a particular line of the students' written calculations.

As stressed in the previous chapter, some productive means were more flexible than others. While Richard, in the example mentioned above, needed to be able to see and point to the line in the student's book in order to turn it into an artefact for assessing and steering the student's participation in the task, he could have produced verbal instructions from any location in the room. However, moving between the students to talk to them also had the advantage of clarifying who the teachers were addressing. Instructions to some students would often distract other students at whom the instructions were not directed, and the issue of clarifying the intended receiver of a message became particularly pertinent in attempts to have different students work on different parallel tasks.

The communication of some artefacts depended mostly on whether they were *seen* by the students. Gestures, writing, visual depictions and objects generally needed to be seen in order to gain a role in steering students' participation in tasks. Other artefacts needed to be *heard*. The communication of spoken language and sounds rested on students' ability to hear what was uttered by the teacher. Lastly, some objects also needed to be *handled* by the students. For example, in the example of Isabel's improvised music game, she picked up and handed a teddy bear to a student as part of setting up the game, instructing students to pass around the teddy bear as long as the music was playing.

Standing and sitting in different places in the classroom gave different opportunities for making artefacts seen, heard or handled by the students. The location of the teacher in relation to the students was both a constraining and enabling circumstance during in-the-moment teacher decision-making. It was a circumstance that the teachers were to some extent able to adapt, simply by moving from one place in the room to another, like in the example above, where Emma utilised both the position of in

front of the whiteboard and the position among the tables. The layout of the classrooms, however, made some positions easier to occupy than others. Moving to a different position in the room, or any changes to the layout of the room (moving tables or moving a student to a different seat), took time. During their in-the-moment decision-making, the teachers mainly utilised the space in front of the whiteboard and spaces next to student tables. There were, however, exceptions, for example when teachers asked the students to get up from their chairs to gather in a particular spot or to move around the room as part of a task.

As presented in the previous findings chapter, the case teachers were found to use artefacts to redesign problematic student tasks. When enacting in-the-moment decisions, the teachers used artefacts to try to steer the participation of their students. In other words, they used the artefacts for explicit mediation of students' activities (Wertsch, 2007). A similar analytical focus on the role of artefacts has previously led researchers note the significance of the physical positions of teachers and students during classroom interaction. In a study focusing specifically on the use of visual depictions (models outlining predictions about simple machines) in science teaching, differences in teacher and student locations were shown to offer different opportunities for participation (Roth, McGinn, Woszczyna, & Boutonne, 1999). Comparing whole-class discussion with small-group interaction, Roth et al. illustrated how physical position afforded different opportunities for seeing, commenting, pointing to and writing on the visual depictions that were the centre of their discussions.

Although the present study's focus on in-the-moment teacher decision-making differs from the science teaching study mentioned above, the shared interest in artefact use has drawn the attention to the practical circumstances concerning position and physical layout of the teaching space. However, instead of focusing on one particular

artefact, like the visual models of simple machines in Roth et al.'s science teaching study, the present study considers the broad range of artefacts by means of which teachers attempt to steer the participation of their students. Furthermore, while the science teaching study mentioned above focused on the conditions for student participation, the analysis in the present study takes the perspective of the teacher, looking instead at the conditions for teachers' steering of student participation and redesign of problematic tasks. The specific focus on the decision-making of the teachers highlighted how physical position enabled and constrained the teacher's use of artefacts when challenging teaching situations arose. In order to achieve task redesign during their in-the-moment decision-making, the teachers needed to communicate the artefacts to the students and make sure that artefacts reached the right students at the right time.

7.3 Students' Familiarity With Task Scripts

During their in-the-moment decisions, the case teachers often achieved redesign of problematic student tasks without specifying all three task components (goals, procedures and resources). For instance, while a teacher would use a written question on a PowerPoint slide to specify the task goal, this was not necessarily followed up with specifications of procedures and resources. Students were seemingly expected to guess the task procedures and resources without further communication from the teacher. Although the task would seem underspecified to an outsider, the students were, however, often able to tap into shared understandings about what tasks involved. For instance, upon receiving a specification of a task goal in the form of a question on a PowerPoint slide, students would, without further directions, follow the procedure of individually writing answers and use personal notebooks and pens as resources.

The following example from the language teacher Isabel's teaching illustrates how the use of artefacts would sometimes leave task components of students' tasks unaddressed. In this particular example, which was also mentioned in the previous chapter, Isabel's use of artefacts in her task redesign targeted only the task resources. Writing eight letters to categorise words on a PowerPoint slide was all Isabel did to satisfy the arising demand of saving some time. In this vocabulary task, students matched Spanish words about weather conditions with pictures, both words and pictures featuring on a PowerPoint slide. In the post-lesson interview, Isabel said the following about her decision to alter the tasks:

> "I realised that actually it [the slide] said to match up and that would normally mean that you would write down the vocabulary but I suddenly remembered that they'd written all the vocabulary last lesson, so I was like actually there is no, that's a waste of time, so I said my time is wasted, their time. That's why I changed it quickly to letters so that they wouldn't be repeating something that they'd already done." (Isabel, interview)

By writing eight letters on the PowerPoint slide, Isabel gave her students new resources to do the matching task. The slide itself specified that the goal of the task was to match words and pictures, and this goal was left unchanged. Importantly, Isabel did not target the procedure of the task with any artefacts, although, as she mentioned in the interview, it was the task procedure she tried to change. As she explains in the interview, providing students with words in a matching task "would normally mean that you would write down the vocabulary." By providing letters instead, Isabel seemingly assumed that students would also follow a different and less time-consuming task

procedure: writing down letters instead of the words. As evident from the observation excerpt below, Isabel let the students start the matching task without specifying the change in procedures:

> 'Isabel tries to write a letter on the slide, thereby categorising the boxes with words on the slide. The slide shifts as she writes (because it is an interactive smartboard). Isabel walks to the computer, shifts back to the slide and presses something on the screen. The screen says 'Freeze screen'. Isabel adds letters to each of the 8 boxes with words. In the right-hand side of the slide are eight pictures of different weather conditions. These are numbered. Isabel says that the students can start. The students start, talking quietly about the slide, connecting the words with the pictures by writing in their books. Most students are writing. Some talk with one another and some write in their book. Occasionally, one of the students stands up to be able to see the pictures and words on the slide.' (Isabel, observation)

From the perspective of Isabel, the task became problematic as she realised that her students had previously written down the vocabulary. The realisation gave rise to a motive-orientation of speeding up the task. Isabel satisfied this motive-orientation by redesigning the initial problematic task, steering students towards a less time-consuming task procedure. Isabel did not target the task procedure directly through her artefact use. Instead, she only provided new task resources by writing letters on the slide, letting her students guess the new task procedure.

In the example above, the students showed no signs of confusion about the task procedure. Also Isabel herself, in retrospect in the post-lesson interview, evaluated the

task redesign as successful: "I changed it quickly to letters so that they wouldn't be repeating something that they'd already done." The task redesign was achieved without specifying the task procedures, but what enabled Isabel to assume that her students would only write down letters and not words? When seeing Isabel add letters to the slide, how would the students know that they were expected to write down letters instead of words?

Examples like the one above suggest that the case teachers relied on students' understandings and expectations about tasks. As the example below will illustrate, the case teachers had a central role in building up such understandings and expectations over time. During their in-the-moment decision-making, the case teachers often relied on what had been built up over time. They used artefacts to appeal to established understandings and expectations in their attempts to redesign problematic student tasks.

When talking about her teaching in more general terms, Isabel was emphasising how she would invest considerable time and energy at the start of a school year, and when starting with a new group of students, to ensure that they knew her expectations. From the letter-example above, such expectations seemed to be central to her ability to quickly communicate changes to tasks. Because established conventions became part of the challenge for Isabel in this example, it made the role of student task conventions particularly visible.

Another example of Isabel's decision-making also made the role of student task conventions visible. In this other example, she specifically used a verbal artefact to remind students about conventions she had built up with her students in the previous school year. In this example, Isabel improvised unplanned task procedures to ensure that every student had a speaking partner. While she had first asked the students to "swap and say to the next person what you were told", she found a way to quickly redesign the

task procedures by means of the following verbal artefacts: "Let's just do a big circle like we did in year 7." While this verbal artefact specified the task procedures with the words "Let's just do a big circle", the latter part of the sentence ("like we did in year 7") appealed directly to a particular understanding of these procedures, which Isabel had built up with this particular group of students during the previous school year.

The role of student task conventions was by no means confined to the two examples above. The ways in which the case teachers used artefacts to appeal to students' understandings and expectations were, however, far from uniform. In working with the data, one particular conceptual development helped better capture the role of students' understandings and expectations about tasks. This theoretical specification followed Cole's (1996) suggestion that, in the coordination of collective activities, the role of artefacts can be understood in relation to the notion of scripts.

While the notion of scripts originally derives from cognitive psychology, Cole (1996) highlights the concept of scripts as a way to understand relationships between artefacts and intersubjective or collective understandings. Cole's suggestion is in line with this study's conceptualisation of artefact use, which was detailed in the theory chapter, where artefacts are seen as both material and conceptual at the same time (Cole, 1996; Ilyenkov, 1977; Wartofsky, 1979). The conceptual aspect derives from the production and use of these artefacts for particular purposes. When individuals are acquainted with the use of particular artefacts, they are also potentially reminded of such use when encountering these artefacts (Wartofsky, 1979). This is what Ilyenkov (1977) calls the ideal side of artefacts, the other side being material. Following these general ideas, Cole emphasises that individuals, when they use artefacts, tap into established cultural models for how activities unfold. These cultural models, in turn, help organise individuals' understandings and participation in those activities. Cole

suggests that the concept of scripts offers a way to unpack how the coordination of collective activities follows an intricate interplay between artefact use and cultural models that have built up over time.

Following Cole's (1996, p. 126) definition, a 'script is an event schema that specifies the people who appropriately participate in an event, the social roles they play, the object they use, and the sequence of actions and causal relations that applies.' Cole stresses that scripts should be understood as 'dual entities, one side of which is a mental representation, the other side of which is embodied in talk and action' (p. 126). In other words, external artefacts are assumed to, at one and the same time, be involved in the realisation of a script and being partly responsible for making the script recognisable to those involved in the activity. For example, it is likely that a menu card plays a central role in both the realisation and the recognition of a how-to-order-food-at-a-restaurant script.

When used here, scripts are not understood as determinants of the participation of those involved in the activity. First of all, it is assumed that often considerable freedom is offered due to lack of specificity of scripts. Secondly, the role of scripts is here seen as relating to the communication about how to participate. In other words, the students may recognise the scripts without wanting to participate accordingly. Thirdly, the coordinating function of scripts is assumed to be limited by differences in the teachers' and students' personal sense of particular artefacts. If some students are reminded of particular scripts, these may differ from those of other students and from those recognised by the teachers.

While the notion of scripts leaves room for misunderstandings and non-compliance in the classroom, it does offer a way to conceptualise the teachers' reliance on students' understandings and expectations about tasks. It provides a way to get at

questions like those raised by the examples above: when seeing Isabel add letters to the slide, how would the students know that they were expected to write down letters instead of words? It offers a possible explanation for the case teachers' ability to efficiently specify student tasks without necessarily addressing all of their components.

Attention to the relationship between artefact use and tasks scripts made visible how students' familiarity with task scripts both enabled and constrained the case teachers' use of artefacts. Like in the above examples from Isabel's teaching, students' familiarity with task scripts made it possible for the case teachers to quickly redesign problematic tasks, without having to engage in elaborate specification of all of the task components. Taking advantage of the availability of a well-established task script was, however, only one of the ways in which students' familiarity with task scripts shaped the case teachers' use of artefacts. As briefly illustrated below, students' familiarity with task scripts was important in a number of different ways for the case teachers' use of artefacts.

In some examples of in-the-moment decision-making, students' inability to recognise task scripts shaped the case teachers' use of artefacts. One example of this comes from the science teacher Michael's lessons. As already mentioned earlier, lessons in the school often started with a so-called 'starter' task, which involved students working independently for the first minutes of the lesson, starting immediately as they come into the classroom. In this particular lesson, Michael engaged in in-the-moment decision-making as he saw the need to redesign the starter task:

> 'Michael says after a minute (Michael hasn't addressed the whole class before this and most of the students have been sitting down for at least 1 minute): "Where can I see people doing the starter?" One student: But what is the starter? Michael

> has put a picture of a thistle-looking flower on the slide and points to it. The slide does not have any text. Michael says: Why do you think I have put this picture on there?' (Michael, observation)

From the slide Michael had put on, at least some of the students were unable to understand what they were supposed to do. They did not recognise the pictures on the slide as part of a task script which could make Michael's expectations intelligible to them. Although starter tasks were usually self-explanatory to the students (which would allow them to start and work independently without further communication), Michael in this example had to use a number of artefacts to specify the task. In this example, Michael responded to the confusion about the starter tasks by moving on to a plenary questions-and-answers task, providing multiple verbal questions and verbal feedback on students' answers, and putting on three more slides with pictures. In this example, students' inability to recognise the task script meant that Michael instead used a number of artefacts to replace the problematic 'starter' task.

In another example, which was presented in detail in the previous chapter, the task script that the students recognised did not match the motive-orientations of the teacher, leading to artefact use by means of which the teacher sought to break out of an established script. In this example, Emma used a number of artefacts to modify the students' understandings of a presentation preparation tasks. Reflecting on this specific lesson, Emma highlighted the challenges of keeping the students "focused instead of just wanting to be very creative." Emma sought to draw students' attention to the intended task goal: "I had to keep reminding them that they had to mention techniques and structure and language, and they can get carried away with making a show." As Emma stressed in the post-lesson interview, her students liked to be creative and

generally enjoyed freer tasks. Providing an alternative to more tightly structured tasks was also a part of Emma's rationale for the presentation task: "We used to do a lot of group work and presentations, but with the poetry unit it is more about writing and stuff, so I wanted them to still have this chance to present their ideas as a group."

Although Emma used several artefacts to draw the groups' attention to the importance of interpreting poems in their presentations, at least some of the students were much more focused on finding creative ways to present. Despite Emma's emphasis on the importance of analysis of poems, some of the students seemed to understand the task differently. For them, Emma's request for a group presentation was understood in relation to a task script where the goal was to prepare an entertaining presentation. For these students, the procedures included coming up with and practising creative ways to present and the resources were any props (chairs, bottles etc.) available in the room that could help make the presentation entertaining. Emma did not oppose this script entirely. For instance, in introducing the task, she did say "If you want to act it out that is fine." Also, for example, when a student asked "Can I sing my poem?" she accepted this, however, without praising the suggestion: "You can sing your poem if you want to."

Although Emma did not forbid the students' pursuit of the task script relating to the preparation of entertaining presentations, she did use a large number of artefacts to negotiate the goal, procedures and resources of the task, trying to ensure that her motive-orientation towards detailed poem analysis was not overshadowed by the prevailing script of making entertaining presentations. As shown earlier, Emma did so in a number of ways. She moved between student groups, asking questions about the poems they had been given. After these questions to the groups, Emma specified the task goal by putting on a slide with six questions for the students to answer in their

preparation of the presentations (e.g. "What do you think the poem is about?" and "What is the tone?"). Emma then addressed the whole class: "Can I remind you that the questions are the most important." She also followed up this specification with a justification of the task goal, saying that she would be "much more impressed with a group that can analyse the poem than act it out."

The central role of students' familiarity with task scripts was also visible in examples where such scripts were absent and where the teachers therefore used many artefacts to ensure specification of task goal, procedures and resources. The example from Brian's teaching where his students did not understand the rules of a board game illustrates this. The students had not previously played this board game. Responding to the students' lack of understanding of how to play the board game, Brian had to use many different artefacts to specify and assess task procedures. Brian targeted the procedures of the task by briefly describing the game verbally. Moreover, he used the written instruction sheet that came with game, saying that the students should take the sheet and follow the instructions. He furthermore assessed the task procedures by asking a particular group of students: "Do you know what you are doing?" With this group, he also talked through one round of the board game, using both verbal artefacts and the paper pieces that made up the game. He then went to another group of students, where he again used a verbal artefact to assess task procedures, asking the students whether they had written down the outcome of the game. Lastly, he specified the procedures by saying that they needed to write down the outcomes.

As shown in this section, the conceptual specification of the relationship between artefact use and task scripts helped explicate how students' pre-established understandings of tasks were central to the case teachers' use of artefacts during in-the-moment decision-making. The case teachers used artefacts to appeal to, negotiate and

make up for the absence of task scripts. The previous chapter described the function of artefacts as tools for reconfiguring the goals, procedures and resources of problematic student tasks. The present section has shown how this function depended on continuous interaction with task scripts that were recognised by the students. These task scripts had been built up over time, prior to the in-the-moment decision-making, and, as detailed in this section, they offered particular opportunities and challenges for how the case teachers could redesign problematic student tasks by means of using artefacts.

7.4 Acceptable Modes of Communication

Comparison between the five case teachers made visible considerable variation in the modes of communication through which they used artefacts. At any given point in their in-the-moment decision-making, there was a close relationship between the overall mode in which they communicated and the artefacts they used. Furthermore, looking across the five case teachers, there were differences in the modes of communication that they adopted. The comparison between the examples below illustrates such differences in modes of communication.

In the first example, the mathematics teacher Richard enacted a redesign of a problematic student task in a calm and instructive fashion. It was in the very beginning of a lesson and he had just discovered that many of his student were away on a trip. He quickly concluded: "I might have to change my plan then." He resolved the challenge by moving on to a different task than the one he had planned, using a PowerPoint slide from a different lesson with another group of students. Despite the surprising news that the students were away, and potentially as part of seeking to counter the development of

an uneasy atmosphere, Richard calmly put on the slide and instructed the students to attempt its four mathematics questions:

> "Richard puts on a slide with four mathematics questions, projecting it to whiteboard (the same slide was used with another class earlier that day). Richard says: "Well, see if you can do these ones" (referring to the slide).' (Richard, observation)

In comparison, an example from Emma's teaching shows a very different mode of communication. In this example, Emma maintained a teasing and humorous mode. She communicated in this mode both in her first task redesign move, where she attempted to speed up the students independent writing task, and in her second redesign move, where she replaced the writing task with a peer assessment tasks.

In her attempt to speed up the students' writing, the role of Emma's teasing and humorous mode surfaced in particular in an interchange where she referred to the idea of 'teacher minutes', which was also discussed in the previous chapter, and which she had earlier in this lesson jokingly admitted as being longer than actual minutes:

> 'Emma says: Two minutes (as in two minutes left). Just after, she adds: Seriously (as in, these are real minutes, not 'teacher minutes'). A student in the front that talked to Emma before says: Twenty minutes, guys! Emma looks at the boy.' (Emma, observation)

Immediately after this interchange, Emma quieted and hurried up the students in a teasing and humorous way, pretending that she thought the students had already finished their writing:

> 'Emma sits next to one student, squatting. Seven students are talking, voices in the room getting loud. Emma: Shush, I take it you are all finished? One student: No! Emma: One more minute. One student commenting. Emma says: Real minute.' (Emma, observation)

The teasing and humorous mode of communication continued also after Emma had checked the time on the computer (realising that the clock on the wall showed the wrong time). Emma wanted the students to move on to a peer-assessment tasks, and in specifying the procedures of this task, she made a joke, maintaining the teasing and humorous mode. Her joke used the name of the specific style of paragraphs the students were practising, 'PEE' paragraphs, which was an abbreviation of 'Point, Evidence and Explanation':

> 'Emma says something about that the students should be sharing their PEEs. Referring back to her comment about the PEE-paragraphs, she then says: Please don't share your pee (as in urine). She smiles when she says that and at least two students comment.' (Emma, observation)

While Emma, as shown above, maintained her mode of communication throughout both of her task redesign moves, the case teachers also sometimes changed mode as part of enacting in-the-moment decisions. Such change of mode can be illustrated by returning to the example where Brian sought to help his students understand a board game about the justice system in Saxon England. In that example, Brian started in an informal and supportive mode of communication, as illustrated in the observation excerpt below:

> 'Brian asks the five-boy group if they know what they are doing (i.e. whether they know how to play the game). Brian walks to the three-boy group, asking them: "Do you know what you are doing?" The boy with glasses (i.e. the boy that has been very active throughout the lesson) says: "Yes, we have to find them and kill them."' (Brian, observation)

After having maintained his informal and supportive mode of communication in his attempts to help the students understand the game, Brian took on and used a much more authoritative and commanding mode. He used the authoritative and commanding mode to replace the board game task and move on to a different task:

> 'Brian: "3,2,1" and he rings the reception bell on his desk. The classroom is quiet. Brian: "Much better." Brian: "You should now have had a go." A student: "No." Brian: Shush (as in be quiet)! Brian says that the students should use the "information" from the game (and I think he mentions from some other places) to answer the question that he has on the PowerPoint slide. The slide reads "Plenary question" and then a question about systems of crime and punishment. The slide also has a box with sentences describing a "good answer", a "great answer" and a "superb answer" respectively. One of the girls from the five-girl group says something. There is noise from the five-boys group. Brian says to the whole class: Using the information, "how different is the system of crime and punishment in Saxon England (i.e. from the present-day system)?" Brian also asks: "Any questions?" No students ask or have hands up. He then

says: "You've had a whole lesson of play, now it is time to work."' (Brian, observation)

The modes of communication were closely related to the artefacts that the teachers used during their in-the-moment decision-making. The relationship between communicative mode and artefact use was two-way. The teachers used artefacts to realise the communicative modes, while the artefacts tended to fit the established communicative mode. In the example above, Brian's use of the sound "shush" fitted well with the authoritative and commanding mode, while it also was part of bringing about this mode. Similarly, Brian's use of the reception bell, the counting down and the "Any questions?" all fitted well with the authoritative and commanding mode of communication, as did his verbal remark "You've had a whole lesson of play, now it is time to work."

In contrast, prior to his shift, when Brian was communicating through the informal and supportive mode to help his students understand the board game, he addressed individual groups of students with the supportive question "Do you know what you are doing?" With one group, Brian used the pieces of the board game to show a sequence in the game, playing it with them. With yet another group, he used a verbal question and a request to get students to write down notes about the process or outcome of the game. He also used verbal artefacts to explain to a group of students about a particular type of punishment. Brian's artefact use in the informal and supportive mode of communication would *not* have fitted well with the authoritative and commanding mode.

The modes of communication created both boundaries and opportunities for artefact use. For example, as illustrated above, Emma's teasing and humorous mode provided the opportunity to make the joke "please don't share your pee." Emma's

teasing and humorous mode at the same time established boundaries in terms of which artefacts that would fit. It would, for example, have marked a departure from her teasing and humorous if she had done as Brian, saying: "You've had a whole lesson of play, now it is time to work." Nor would Richard's above-mentioned use of the verbal artefact "Well, see if you can do these ones" have fitted well with her teasing and humorous mode.

Analytic attention to the relationship between form and content of the case teachers' communication of artefacts was stimulated by the idea that 'voice' and 'message' are connected. This relationship has been highlighted by Eddy Spicer and Daniels (2013) as an analytical entry point into understanding how the role of artefacts is structured institutionally, drawing attention to the ways that "(d)ifferent social structures give rise to different modalities of language which have specialized mediational properties" (p. 20). Following such perspective, the analysis drew on the idea that socially acceptable communication of artefacts depends on the subject positions individuals are able to assume, and on whether those subject positions allow 'voices' (modes of communication) through which 'messages' (artefacts) can be communicated.

The previous section about the role of task scripts made visible that the teachers, through their use of artefacts, engaged with prevailing understandings and expectations that had built up over time. The attention to task scripts and students' understandings did *not*, however, explain why the students would accept the teachers' attempts to regulate their actions. While understanding was an important prerequisite for compliance with the teachers' expectations about task goals, procedures and resources, the students also had to recognise and accept that the teachers had the authority to redesign tasks.

From the relatively low number of artefacts that the case teachers used to justify configurations of task components, it seemed that the teachers were largely assuming that the students would participate in accordance with their in-the-moment task redesign. The attention to differences between modes of communication, however, made visible how the teacher did more to gain students' acceptance than initially noticed. The teachers drew on different modes of communication that placed them, in relation to the students, in certain positions of authority, from which they could steer their students' participation in tasks.

The relationship between positions of authority and modes of communication can be illustrated using the three examples mentioned above. Richard was, with his calm and instructive mode of communication, signalling that he was still in control of how the lesson should unfold, despite the surprise that half of the students were away on a trip. Brian, in the example above, switched to an authoritative and commanding mode to show that he was very serious about the students needing to follow his instructions very carefully. Emma, who was worried that her students would resist the demanding work of writing PEE-paragraphs, sought to gain the students acceptances by adding some liveliness through a teasing and humorous mode of communication.

Table 17 below outlines the interpretation of the case teachers' modes of communication within each of the analysed instances of decision-making. The middle column lists the analyses of the teachers' modes of communication, summarising and formulating these for each of the observed instances of in-the-moment decision-making. As already highlighted above, using the example from one of Brian's lessons, the teachers sometimes shifted their mode of communication during the enactment of their decisions. Such shifts are indicated in the middle column with the sign =>. The right-hand side column formulates an indication of the subject positions that each of the

teachers seemingly tended to adopt and communicate from, by choosing the particular modes of communication.

Table 17: Modes of Communication Across the Analysed Instances of Decision-Making

Teacher	**Modes of communication**	**Subject positions**
Brian	Informal and supportive => Authoritative and commanding	Overseer of order
	Storytelling and informative => Overseeing order	
	Monitoring democratic decisions	
	Overseer of order	Informal storyteller
	Watching over and guiding => Educating about good character and attitude => Storytelling and informative	
Emma	Impatient and eager to see students' work	Friend of the students
	Commenting and suggesting (guiding) => Enquiring and supportive	
	Teasing and humorous	Strict rule-setter
	Threatening and serious => Pressuring	
Michael	Punishing => Irritated => Instructing	Instructor
	Slow and calm => Pressuring	
	Pressuring => Comforting	
	Pressuring	Punisher
	Inspire => Managing => Punishing => Instructive	
Isabel	Orchestrating	Conductor
	Orchestrating	
	Orchestrating => Clarifying => Orchestrating	
	Warning about consequences => Checking => Orchestrating => Refereeing	Enforcer of clear expectations
Richard	Guiding and instructing formally	Instructor
	Enquiring => Entertaining and informative => Enquiring	
	Encouraging => Entertaining and joking => Instructive and serious	
	Entertaining	Entertainer
	Calm and instructive	
	Instructive => Joking => Instructive	
	Inventive and joking => Corrective and guiding => Inviting and instructive	
	Inviting and instructive => Disapproving and correcting	

The inclusion of Table 17 above is not intended to suggest that the subject positions it mentions were the only positions the teachers were able to adopt. What it does indicate is that the teachers had built up some particular ways of communicating with the students, having established these over time, prior to when the specific instances of in-the-moment decision-making arose. In their enactment of in-the-moment decisions, the teachers were then able to rely on modes of communication that the students expected and accepted on the basis of the subject positions the teachers had built up.

Because of the structure of the data, it does not allow examination of how the subject positions arose, or whether they were indeed persistent over time. From the micro-level analysis of the instances of decision-making, the ways that the students responded to the teachers' communication did, however, indicate that the teachers needed to orchestrate their use of artefacts according to established external expectations about their modes of communication. The micro-level analysis of the classroom interaction, along with the teachers' emphasis on building rapport and shaping of students' expectations, suggests that the availability of modes of communication rested on the particular social relationships and expectations that the teachers had been able to build up in the school in general and with their students in particular.

The teachers' dependence on social relationships and expectations became visible both when their modes of communication were challenged by students and when students contributed to the maintenance of particular modes. An example of the latter was Emma's teasing and humorous mode, which was described above, where students several times supported her mode of communication, in particular by contributing to the building up of jokes about the long 'teacher minutes'. As mentioned above, one student,

for instance, responded to Emma's two-minutes-left announcement by stating "Twenty minutes, guys!" thereby referring to previously established jokes about the length of 'teacher minutes'.

The above example from Brian's teaching, on the other hand, provides an example of a student challenging his mode of communication. In the example, Brian's shift into the authoritative and commanding mode was resisted by one student, who said "no" when Brian declared that all the students should now have had a go at playing the board game. Although challenged, Brian continued the authoritative and commanding mode, rounding off his introduction with a statement indicating that the students should now expect a change in tone and approach: "You've had a whole lesson of play, now it is time to work."

All of the case teachers had in common the formal institutional position of being full-time teachers at the school, and they thereby formally had the authority as well as the responsibility to steer the teaching activities. This, however, would not account for the differences in the ways they positioned themselves through uses of various modes of communication. The analysis of the instances of their in-the-moment decision-making suggests that, for the different teachers, some subject positions were more readily available to them than others. For each of the teachers, some modes of communication seemed to be easier to adopt when redesigning problematic tasks, and the reliance on these modes of communication both structured the use of artefacts and were maintained through the use of artefacts.

7.5 Interweaving of Physical and Cultural Circumstances

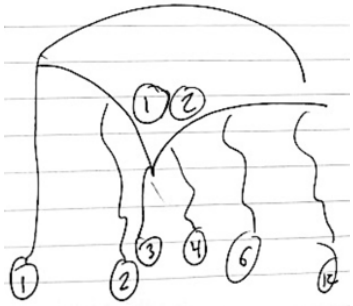
This summary section of the chapter emphasises that the physical and cultural circumstances presented in the previous sections were in fact all at play at once. The physical and cultural circumstances presented in the previous sections were described separately to clearly specify each of the concepts and the insights they enabled about the case teachers. In using artefacts to enact in-the-moment decisions, the teachers, however, had to attend to all four aspects simultaneously: the means for producing the artefacts at the right time, the different points in the room from which they could communicate with the right students, the students' familiarity with and potential misunderstandings of task scripts and, finally, the modes of communication that would make students likely to accept the suggested task redesign.

Importantly, as also stressed in the theory chapter, the different aspects of the teaching situations were not seen as factors or variables that influenced the teachers in a unidirectional way. Rather, these external arrangements, which had built up already prior to the decision-making situation, were used by the teachers in their attempts to deal with and pursue challenging motive-orientations. In other words, using the metaphor from Cole (1996), the teachers were interweaving these circumstances into their enactment of their in-the-moment decisions to pursue particular ends. Their 'weaving threads', so to speak, were the strings of artefacts that they employed, and the teachers' use of artefacts was both enabled and constrained by the situational circumstances. To illustrate the interweaving of the four circumstances that were described in this chapter, an example from Richard's teaching is considered in detail below.

The example used below is the instance of decision-making that was included in the introduction chapter (see p. 10), where the mathematics teacher Richard stopped his students' independent work to explain 'factors' and 'square numbers' by drawing on the whiteboard. As noted in the introduction chapter, Richard's in-the-moment decision seemed effortless. To Richard, it was entirely unproblematic: "Oh, I have just discovered that students can't remember what a factor is, I'm gonna spend a couple of minutes explaining and reminding them what factors are." Unpacking of this example, however, exposes how Richard's enactment of his decision involved skilful reliance on physical and cultural circumstances. Revisiting this example makes visible the kind of interpretation that was made possible by the concepts developed in this chapter. The example shows that, despite the apparent lack of effort, Richard's enactment of his decision relied on an intricate interweaving of productive means, communicative positions, task scripts and modes of communication.

The example below in Table 18 is a reworking of the original outline of the instance in Table 1 on p. 10 in the introduction chapter. The revised example below in Table 18 includes in the right-hand side column the physical and cultural circumstances he was interpreted to rely on during his enactment of this particular in-the-moment decision. The example thereby brings out the physical and cultural circumstances that had developed over time, prior to when the need for decision-making emerged; circumstances which Richard was able to weave into the enactment of his decision.

Table 18: Example of the Interweaving of Physical and Cultural Circumstances

	Observation	**External supports**	**Circumstances**
1	'[...] Richard stands in the front of the classroom and addresses the whole class by asking: "Who knows what they are doing?" Richard asks the students to put up their hands if they do.	Spoken language: - Question and instruction assessing understanding of task.	Productive means: His voice. Students' gesturing. Whiteboard and pen. Students' voices. Points of communication Position in front of the whiteboard, with all of the students facing him. Task scripts: Self-assessment of students' own understanding by putting up hands. Interactive teacher explanation with questions and answers. Modes of communication: Enquiring => Entertaining and informative => Enquiring
2	One student puts up a hand and then another student puts up a hand. More students put up their hands, hesitating a lot. Richard: "I can see six half hands."	Gesture: - Students' hands. Spoken language: - Assessment of number of hands.	
3	Richard says that he has drawn a fish as he is building up the following drawing on the board:  One student says that it is not a fish. Someone suggest that it is a jelly fish. Richard draws the tentacles as he is talking. Richard explains what a "factor" is by having first 4 tentacles and saying that it is what 12 can be divided by, writing first 12 to the right and 1 to the left. He then writes 2 and 6 and adds two more tentacles in the middle writing 3 and 4. Richard says that these are "factors."	Visual depiction: - The 'jelly fish' drawing. Written language: - Numbers on 'jelly fish' drawing. Spoken language: - Explanations of what he draws and writes.	
4	One student then says: "I get factors; it is the square that confuses me." Richard says that that is what he will move on to now.	Spoken language: - Student's question. - Statement that the next part is about squares.	
5	Richard writes a vertical list of numbers on the right-hand side board: 1, 4, 9, 16, 25. While writing the numbers, Richard says 1 times 1 is 1, 2 times 2 is 4, 4 times 4 is 16 etc. Richard says that these are square numbers and explains further.	Written language: - List of numbers written on the board. Spoken language: - Verbal calculation. - Statement that these are square numbers. - Explanation.	
6	Richard then asks: "How do I decide" whether one of these numbers is a factor? One student: "Divide." Richard says: You divide. Richard stops explaining. Most of the students are now writing in their books or looking up on the board where the 'starter' tasks slide is still on. [...]' (After this point, Richard lets the student work independently on the starter task.)	Spoken language: - Question about calculation procedure. - Student's answer. - Repetition of student's answer.	

As highlighted in the right side column of Table 18, Richard's enactment relied on the availability of several different productive means. Taking each of the productive means in turn provides an illustration of Richard's interweaving of the different situational circumstances. In the first action in Table 18, Richard relied on the flexibility and volume of his voice to interrupt the students from working independently in their books, posing the question "Who knows what they are doing?" when he noticed that some students were struggling with the task. Although he had moved up to the position in front of the classroom, many of the students were looking down in their books, and hence speaking out the question became a way for Richard to reach all the students. Also, the voicing of the question indicated a change in task script from independent work in their books to, instead, self-assessment of students' own understanding by putting up hands. Richard was able to maintain this script of student self-assessment by assuming an enquiring mode of communication which encouraged the student to produce an honest evaluation of their understanding, when asked to put up their hands.

The students' gesturing became available as means for producing relevant artefacts not only through Richard's verbal invitation to a show of hands. His position in front of the classroom made the students' gestures visible to Richard in one glance, giving him the chance to count a total of "six half hands." The students' familiarity with the script of self-assessment through raising a hand made this a quick way for Richard to get an overview, without having to explain further what he wanted them to do, or, for example, without having to ask each student individually.

When Richard turned to the explanation of factors and squares (third action in Table 18), the availability of whiteboard and pen was essential because he wanted to produce the "jelly fish" illustration. The availability of the whiteboard and pen was made useful by Richard's move to the front of the classroom, standing immediately in

front of the whiteboard and with the layout of the tables in such a way that the whiteboard was visible to all the students. Having established the need for explanation through the show of hands, Richard invoked a new task script which the students were familiar with: he drew out the "jelly fish" as a focal point for the script of interactive teacher explanation with questions and answers. To gain students' attention to his explanation, he left his enquiring mode of communication, adopting a communicative mode that was instead both entertaining and informative. He made his drawing and explanation more entertaining by adding surprise and humour, stating, for example, that he had drawn a fish.

Lastly, Richard supplemented his verbal explanations and writing on the board with the students' voicing of answers and questions. The availability of the students' voices as a source of artefacts was enabled partly by Richard's position in front of the board facing all of the students, allowing easy communication between Richard and any student who wished to contribute. The reliance on students' questions and comments was also assisted by the students' familiarity with the script of interactive teacher explanation with questions and answers. Without having to invite student contributions, Richard was able to integrate a student's comments into the progression of his explanation in action four: "I get factors; it is the square that confuses me."

Richard's entertaining and informative mode of communication seemed to encourage some of the students to comment on the statement that he had drawn a fish and to object when his explanation about factors left the idea of square numbers unexplained. To further encourage students' contributions to the building of his explanation in action six, Richard switched once again to an enquiring mode of communication, inviting students' suggestions.

In the example above, Richard found it effortless and straightforward to resolve the challenges arising from his students' lack of understanding of key ideas. Unpacking the moment-by-moment enactment of his decision with the concepts developed in this chapter, however, highlighted circumstances that were crucial in making his course of action practical. These physical and cultural circumstances were present before the need for in-the-moment decision-making arose, and Richard's enactment of his decision relied on the interweaving of these circumstances into a course of action. The decision that was effortless and straightforward for Richard was made practical at this particular moment because he had available the means to produce the specific artefacts, because the arrangement of the classroom with every student facing the whiteboard allowed easy communication, because he could appeal to students' familiarity with scripts about self-assessment and interactive teacher explanation and because Richard had built up a subject position from which his enquiring and entertaining-informative modes of communication were accepted by the students.

8 Discussion

This penultimate chapter discusses the findings of the study through four sections. The first section formulates answers to the research questions by drawing together the findings in a conceptual model. The second section compares the findings with the research literature that was reviewed in chapter two, proposing the focus on artefact use as a way to account for the practicalities of teacher decision-making without psychologising these processes. The third section broadens the discussion and presents an argument for regarding artefact use as an important part of what it takes to teach. The fourth section discusses how the findings of the study can become helpful to practitioners.

8.1 Answers to the Research Questions

This section combines the findings from the two previous chapters into a holistic conceptual model. The model draws together the answers to the research questions. The present section thereby explicates the perspective that was developed in this study, before turning to the discussion of its implications in the subsequent sections.

The aim of the research project was to develop a theoretical framework that can bring out the role of external supports within in-the-moment teacher decision-making and make visible the bearings that physical and cultural circumstances have on the use of external supports in decision-making situations. Systematic analysis needed to start with the establishment of a robust conceptualisation of the phenomenon and corresponding analytical procedures to render it open to empirical study. The strategy

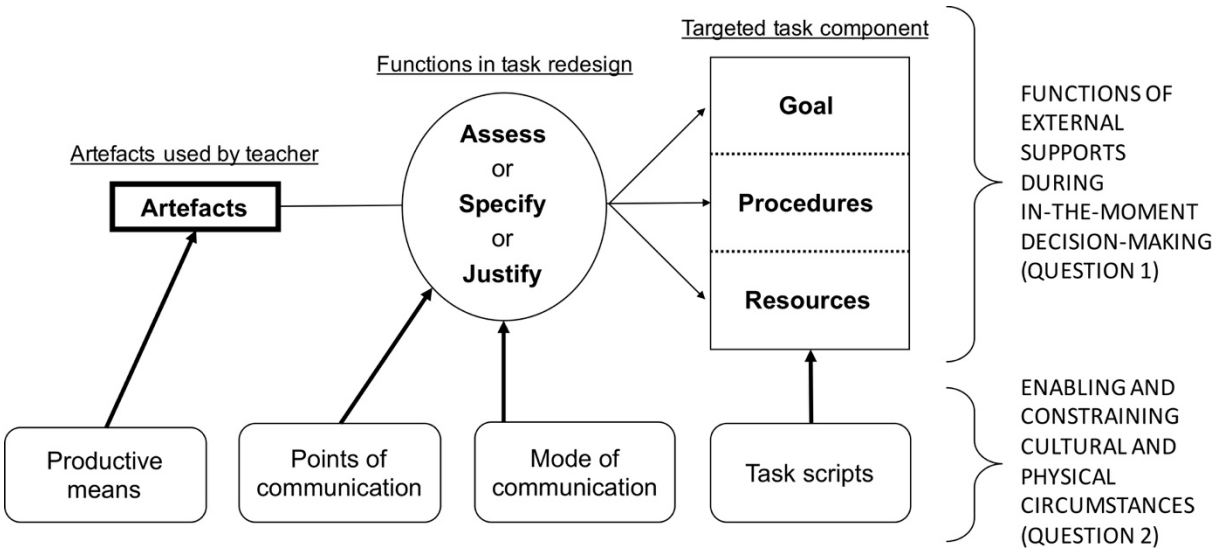
was to develop and refine the theoretical framework through in-depth micro-level unpacking of instances of teacher decision-making, thereby offering concepts and a corresponding analytical approach that can serve as a foundation for future study of teachers' reliance on external supports.

The particular perspective, which guided the examination of the teachers' use of external supports, was based on the idea of artefact mediation. This concept, which was drawn from a cultural-historical research tradition (Cole, 1996; Daniels, 2012b; Hedegaard, 2012a; Valsiner, 2000; Wartofsky, 1979; Wertsch, 2007), directed the analytical attention towards the ways in which the teachers were producing and using external supports (physical objects, writing, visual depictions, spoken language, gestures and sounds) to achieve certain ends, highlighting the interplay between intentions and artefact use.

The specific concepts that resulted from adopting the artefact-mediation perspective are outlined visually in Figure 5 below. By combining the findings from the two previous chapters, Figure 5 brings together the answers to the two research questions:

1. *What role does schoolteachers' use of external supports play in their enactment of in-the-moment decision-making?*
2. *How do physical and cultural circumstances of teaching situations enable and constrain schoolteachers' use of external supports during in-the-moment decision-making?*

Figure 5: Conceptual Framework for Understanding the Role and Circumstances of the Use of External Supports During In-the-Moment Teacher Decision-Making



As indicated on the right-hand side of Figure 5, its top section outlines the answer to research question one. The top section hence conceptualises the role that external supports played in the five case teachers' in-the-moment decision-making, thereby reproducing the depiction of the concepts that were presented in chapter six (see Figure 3 on p. 153). Figure 5 above shows how the artefacts the teachers used were found to play the role as tools for in-the-moment redesign of problematic student tasks. The teachers resolved the challenging teaching situations by orchestrating strings of artefacts in the attempts to steer their students' participation. The top section of Figure 5 specifies that the teachers resolved challenging teaching situations by using artefacts to assess, specify and justify the goals, procedures and resources of problematic student tasks.

The bottom section of Figure 5 outlines the answer to research question two. It thus presents the aspects of the teaching situations that enabled and constrained the

teachers' use of external supports during in-the-moment decision-making. The focus of research question two was on circumstances that had built up prior to the need for in-the-moment decision-making. As stated in the bottom section of Figure 5, these circumstances included (1.) the means for producing the artefacts at the right moment; (2.) the points of communication which enabled artefacts to be seen, heard or handled by students; (3.) the modes of communication that would provide the teachers with authority to steer student participation; and (4.) the students' familiarity with task scripts. As stressed in chapter seven, these circumstances were all at play at once, requiring the teachers to interweave all four aspects of the teaching situation into the enactment of their decisions.

The arrows connecting the top and bottom parts of Figure 5 indicate the interpretation of the relationships between the situational circumstances and the teachers' artefact use. The arrow on the far left in Figure 5 highlights that the availability of productive means was important for whether the teachers could produce the artefacts. The next arrow to the right points out that the communication, through which the teachers used artefacts to assess, specify and justify tasks, hinged on the adoption of points of communication from which students could hear, see and handle the artefacts. The third arrow foregrounds that the teachers needed to adopt acceptable modes of communication through which they could gain students' cooperation in the assessment, specification and justification of tasks. Lastly, the arrow to the right specifies that the teachers' targeting of task goals, procedures and resources involved appealing to and engagement with students' familiarity with task scripts.

Summarising the findings visually in Figure 5 helps to emphasise that, for every artefact the teachers used to enact their decisions, their reliance on those artefacts involved multiple components. It was in the coming together of these different

components that the artefacts became operational as tools for enacting teacher decisions. When faced with challenging teaching situations, the teachers attempted to satisfy problematic motive-orientations by trying to change the classroom activities in specific ways. In these moments, the use of artefacts became operational through their role in the teachers' assessment, specification or justification of task components (goals, procedures and resources). At the same time, this role of the use of artefacts hinged on the teachers' ability to interweave the artefacts into the particular circumstances of the teaching situation in ways that suited the desired change of the classroom activities.

To illustrate the multifaceted dynamics of the teachers' use of artefacts that was foregrounded by the analysis, the teachers' use of the sound 'shush' can serve as an example. First of all, the presence of the sound would not be enough to make it an artefact in a teacher's enactment of a decision. It would need to be used by that teacher in the attempt to change the activities to satisfy a problematic motive-orientation (for example to avoid students distracting each other). The teacher could do so, for example, by using the sound to specify the procedures of the task (communicating that independent work means no talking). To be able to produce the sound, the teacher would need to use his or her voice, potentially having to momentarily break off from talking. The use of the 'shush' sound would be flexible in the sense that it could be heard by all the students, regardless of the teacher's position in the room, although communicating from a point in front of the class could help the teacher indicate that the sound was addressed to all the students and not just a specific group. Furthermore, for the use of the sound to be useful in steering the participation of the students, the students would need to accept the communicative mode through which the teacher used the 'shush' sound (for example an authoritative mode indicating possible consequences for the students, or a calm instructive mode simply reminding students). Lastly, for the

use of the sound to be operational in specifying the task procedures, the teacher would be helped by using it through an engagement with a task script that was familiar to the students (for example by appealing to their understanding that independent work usually means no talking, or as a way to counter students' expectation that they would be working in groups).

As shown in the two previous chapters, the teachers used strings of *multiple* artefacts to enact their in-the-moment decisions. To provide a simple illustration, the example above of the use of the 'shush' sound considered the use of only one artefact. Figure 5 above similarly outlines the conceptual relationships relating to the use of a single artefact. It is therefore important to stress how these dynamics multiply in the use of strings of several artefacts. When enacting their in-the-moment decisions, the teachers located not only one, but a whole number of artefacts, which were all used through an intricate engagement with the specific situational circumstances to make them operational as tools for redesigning the relevant components of problematic tasks.

A strength of Figure 5 is that it brings together the findings into an integrated model. As discussed in the theory chapter, the relationships explored in this study are not seen as discrete variables influencing one another. For example, the claim made here is *not* that 'mode of communication' influences or in some way increases 'assessment, specification and justification' of task components. Instead, all the elements in the model depend on one another and the dynamics the model outlines analytically are only meaningful when considering in full the complete action which the model describes. In line with the aim set out in the introduction, it is a holistic model which seeks to bring together the external practical aspects of artefact use during in-the-moment teacher decision-making.

Because of the interdependent nature of the components of the model and the relationships it outlines, it is useful to think of these relationships in terms of *congruence* or *incongruence*. Rather than detailing unidirectional influence, the model contributes with an overview of the relationships that enable or potentially hinder practical use of artefacts during in-the-moment teacher decision-making. For example, in a given situation, the use of one particular artefact may have proven to be incongruent with the mode of communication; or the use of the artefact may have been incongruent with an intended change of task procedures. In such case, the incongruence of those relationships would make the decision more difficult to enact with that particular artefact. In order for the use of the artefact to be practical, congruence is needed between all the different components of the model, which again highlights the elaborate abilities that allowed the teachers to enact their decisions.

The conceptual developments summarised in Figure 5 are important because they enable a detailed, micro-level understanding of the practical aspects of in-the-moment teacher decision-making. The findings detail how the teachers used artefacts to realise their in-the-moment decisions through outward actions. These actions were directed at changing the ongoing classroom activities. The arrangements of the situation made some actions straightforward and others more difficult for the teachers. The dynamics that the findings unpack should not, however, be seen as determining whether an action is possible and not possible. Instead, the findings draw attention to differences in how practical different courses of actions are, entering a pragmatic domain where a course of action may become more sensible for the teacher because it is easier, faster and/or serves better the teacher's intentions. Practical, as it is used here, therefore refers to the congruence between the actions through which decisions are enacted and the external circumstances in which the activity takes place.

The findings summarised above were based on the analysis of a low number of cases and the five teachers all came from the same setting. Whether the answers to the research questions generalise beyond these particular teachers and this specific cultural context is still an open question. As already discussed in the methods chapter, the strategy of this in-depth analysis of a low number of cases did *not* rest on a claim that the cases were representative of a population to which the findings could be generalised. Instead, the aim has been analytic generalisation (Yin, 2014) where generalisations rest on the abstract concepts through which the findings are expressed. It means that generalisation will require future analysis, through which the concepts are used in the analyses of new cases to determine whether they also account well for the dynamics at play in those cases.

Although the evaluation of generalisability remains a task for future research, the findings are significant because they are at odds with the perspectives on teacher decision-making that are available in the research literature. Hence, despite the highly localised empirical basis of the findings, the study demonstrates that there are aspects of teacher decision-making that currently escape our attention. The study shows that an alternative to the focus on internal psychological processes in research on teacher decision-making is possible, and that such alternative perspective can enable detailed accounts of important dynamics relating to the external enactment of decisions. Hence, the study is significant because it offers an alternative view that can help change the conversation about teacher decision-making.

On the basis of the findings summarised above, the alternative view of teacher decision-making which arises from this study can be broadly stated as follows: the decision a teacher can enact is enabled and constrained by the external artefacts that the teacher is able to produce in that particular moment, and by the physical and cultural

arrangements of the teaching situation that make the use of those artefacts instrumental in the intended redesign of the ongoing student task.

If it is indeed found to be applicable more widely, the view of teacher decision-making developed in this research project has implications for the current understandings in the literature. It also has potential relevance to practitioners and their preparation for in-the-moment decision-making. The implications of the findings will be discussed in the remainder of this chapter, focusing in the next section on what this study adds to the literature on teacher decision-making, while the subsequent section will discuss the contribution to the broader literature on what it takes to teach. The final section of this chapter will assess how the findings may become helpful to practitioners.

8.2 Accounting for the Practicalities of Enactment Without Psychologising Them

The conceptualisation developed in this study contributes by offering an alternative to prevailing accounts of teacher decision-making that tend to focus elsewhere than the external dimensions of enacting decisions. This section reassesses the literature on teacher decision-making in the light of the findings of the study, highlighting the need to move beyond psychological accounts and to include a focus on the *dynamics between* what teachers are trying to achieve and what teachers find practically possible within the given circumstances.

As described in the literature review chapter, the dominating approach to the study of teacher decision-making has been the cognitive information processing perspective, focusing on the ways teachers select and integrate information as they make decisions (Shavelson & Stern, 1981). Researchers within this perspective have

stressed the complexity of the information teachers need to process (Leinhardt & Greeno, 1986) and the filtering and structuring that enable fast processing (Feldon, 2007). The focus has been on seeking to describe different cognitive schemata that shape how teachers deal with challenging classroom situations (Berliner, 1987; Borko et al., 2008; Peterson & Comeaux, 1987). Because of the focus on cognitive processing, the role of the external physical and cultural environment features in those accounts only as information that teachers need to process.

The other three main approaches to the study of teacher decision-making that were described in the literature review chapter have also focused on psychological processes. Researchers adopting a sense-making perspective have tended to focus on how teachers interpret long-term changes, such as school reform (Allen & Penuel, 2015; Coburn, 2002; Cohen, 1990; Hill, 2001; Jennings, 1996; Schmidt & Datnow, 2005; Spillane et al., 2002) and professional development initiatives (Allen & Penuel, 2015). The adaption of the reflection-in-action perspective has focused on the role of reflection in initial teacher education and continuing professional development (Bengtsson, 1995; Calderhead, 1989; Colton & Sparks-Langer, 1993; Eraut, 1995; Handal & Lauvas, 1987; Hatton & Smith, 1995; Mackinnon, 1987; Smyth, 1989; Zeichner & Liston, 2014), studying mainly reflection that takes place outside the classroom. An inner dialogue perspective has been adopted to study in-the-moment teacher decision-making as the unfolding of internal verbal discussions inside teachers' heads (Lampert, 1985; Wagner, 1987).

Similar to the cognitive information processing perspective on teacher decision-making, a psychological view of decision-making is maintained in the research literature that accounts for teacher decision-making in terms of sense-making, reflection-in-action and inner dialogue. Because of the particular foci of these

perspectives, attention to the physical and cultural environment enters into their analyses only as aspects of inner psychological processing. The external environment is included in these accounts as something that is interpreted (in the sense-making perspective), reflected on (in the reflection-in-action perspective) or the subject of an internal conversation (in the inner dialogue perspective).

On the basis of an extensive search of the literature on teaching and schoolteachers' work, the literature review in chapter two uncovered and analysed 19 studies that provided some conclusions about the role of teachers' use of external supports during in-the-moment decision-making. These studies indicated that the use of external supports did have a role in the enactment of decisions, but because these studies focused on various other topics, they did not focus their enquiry directly on decision-making and they did not conceptualise the role of external supports.

From their specific findings, as described in chapter two, it was possible in the literature review to mark out themes that ran across the 19 studies. The structured rereading of these studies highlighted five themes: 1) the teachers' use of external supports enabled modification of student behaviour; 2) it provided information about student progress on tasks; 3) it helped indicate possible teacher actions and objectives; 4) it gave the means for continuous orchestration of student participation in tasks; and 5) it provided instructional devices for the facilitation of student understanding. Taken together, these themes from the 19 studies indicated that the use of external supports is instrumental for teachers in their enactment of in-the-moment decisions. However, the piecemeal nature of the findings also showed a need for systematic study and conceptualisation of the topic.

This research project produced concepts through which the role of the use of external supports could be described systematically. By focusing on teachers' use of

strings of artefacts, it was possible to develop a coherent conceptual framework which brought together and enabled a better understanding of the dynamics underlying the above-mentioned themes derived from the reviewed literature. Examining directly the role of teachers' use of external supports during in-the-moment decision-making made visible how artefacts were used to assess, specify and justify components of student tasks, utilising the artefacts as tools for changing their students' participation in the ongoing activities. Furthermore, going beyond the themes indicated in the reviewed literature, the study also showed that, to achieve this tool-like function, the teachers interwove their use of artefacts into the physical and cultural circumstances of the specific situations, relying on the available productive means, points of communication, modes of communication and task scripts.

The study provides a perspective which shows decision-making as unfolding through series of outward artefact-mediated teacher actions which are made practical through their congruence with the specific physical and cultural circumstances. The findings expose how it is insufficient to account for situational circumstances and outward action only in terms of psychological processes because this is likely to limit our understanding of the dynamics involved in dealing with challenging teaching situations. Understanding in-the-moment decision-making only in psychological terms deflects attention away from the tools of external action, and it hinders future insights about interconnected dynamics between psychological processing and the external shaping of what is practical in-the-moment.

An example is helpful in illustrating what is here meant by accounting for the external aspects of decision-making in psychological terms. As will be discussed in the next section of this chapter, research on teacher knowledge has been particularly focused on capturing teachers' interaction with situational or contextual circumstances

in terms of different types of knowledge. Such a 'situated perspective' on teacher knowledge nuances and improves our understanding of what it takes to teach (Putnam & Borko, 2000) but the interest and focus on knowledge, however, restrain the accounts to cognitive processes and content. This may be appropriate for some purposes but it arguably comes with the risk of bypassing potential insights about practical aspects of teaching.

One example that illustrates how knowledge-focused perspectives restrict their accounts to an internal psychological dimension can be drawn from Winch, Oancea and Orchard (2015), who define knowledge in terms of what it enables teachers to do. They identify three interconnected attributes of teacher professional knowledge. The first is 'situated understanding', which they describe as tacit know-how and as 'a capacity to grasp the salient features of a situation, deliberate imaginatively and holistically and to make ethically and practically sound judgments in specific situations' (p. 205). The second, 'technical knowledge', is easier for the individual to articulate and it 'enables the practitioner to plan and control a process' as well as 'to explain and predict the success or otherwise of an intervention' (p. 206). The third is 'critical reflection' which 'implies that the teachers review thoughtfully and systematically what they have done in the past with a view to sustaining or improving their practice in the future' (206).

The example from Winch, Oancea and Orchard (2015) is particularly illustrative because they, through their definitions, carefully seek to include both the doing of teaching and the importance of understanding and reflecting on specific situations. Their account therefore comes much closer to the practical reality of teaching than if, for example, they had pointed only to teachers' knowledge about their subjects. Correspondingly, the argument unpacked here should be seen as an attempt to further such commitment to the capturing of what is involved in the enactment of teaching.

Another example, this one from a recent study that focused on cognitive information processing, further illustrates the tendency to restrict the account of external actions and situations to an inner psychological dimension. Kim and Klassen (2018) used a think-aloud methodology to study how teachers with different levels of experience deal with challenging everyday situations in different ways. The method of having teachers verbally report on their own thinking in response to written scenarios matched their research objective, focusing the enquiry on the teachers' cognitive processing. The way the participants dealt with the specifics of the scenarios and the details of their responses were analysed in terms of the 'way that mental representations are organized' (p. 224). Fully in line with the objectives of their study, the comparison between the participants brought out differences in cognitive structures and processes:

> 'Expert teachers in our study organized their knowledge according to principles and abstractions while those with less experience organized their knowledge according to surface level features. Furthermore, schemas were more accessible and highly developed among experts than among beginning and pre-service teachers, reflected in the different strategies they used to generate and recognize answers.' (Kim & Klassen, 2018, p. 224)

The study presented in this thesis has provided a view of in-the-moment decision-making where situational circumstances are not merely features that teachers can be knowledgeable about or process as information. Analysing the action-by-action unfolding of in-the-moment decisions showed the teachers' active attempts to change classroom activities through outward action, relying on a range of physical artefacts as tools. The building up of the teachers' decisions required more than cognitively selecting a course of action that they estimated would fit the specifics of the situation. In order to satisfy problematic motive-orientations, decisions had to be enacted through a continuous interweaving of artefact-mediated action into the physical and cultural circumstances of specific situations.

As the findings of this study have shown, the dynamics that make the enactment of decisions practical were found to rest on highly specific features of the particular teaching situations and the distinct artefacts that the teachers chose to use, as well as the ways the teacher chose to use them. Hence, in order to study such dynamics, detailed accounts of external dimensions of decision-making are desirable. The findings make visible that accounting for the role of outward action and situational circumstances through descriptions of teacher thinking or cognitive processing creates a roundabout way of including those aspects into the analysis. An analytical model that includes concepts only about the internal psychological processes would have to specify outward actions and situational circumstances indirectly and thereby run the risk of compromising the level of detail in the analysis.

Furthermore, the findings lay bare another problem with portraying all aspects of teacher decisions as results of cognitive processes. In the above-mentioned definitions of teacher knowledge, Winch, Oancea and Orchard (2015) were able to nuance their suggestion about what teaching requires by attending to its complexities, outlining aspects teachers need to be knowledgeable about. This focus on knowledge takes as its starting point an uncontroversial idea which matches the purpose of their definitions: teachers' actions have psychological underpinnings which we can try to identify and explicate. However, by turning the question around, it becomes possible to ask and pursue a different line of questions: during a given instance of decision-making, what is it that a teacher may *not* know or may misconceive? What is it about his or her interaction with the external environment that a teacher is unaware of or only partly grasps?

The findings presented in this thesis do not answer these questions. The findings do, however, make visible that the moment-by-moment enactment of decisions are

likely to present teachers with practical challenges and possibilities that they will not always be able to predict or apprehend in-the-moment. The findings show the need to be cautious about assuming that a resulting decision is a product only of knowledge, cognition or other psychological processes. The inclusion of external enactment and situational circumstances into the analysis of teacher decision-making offers possibilities for noticing unexpected dynamics relating to engagement with physical and cultural circumstances, and, as will be discussed in detail in the latter part of this chapter, it has the potential of providing insights that can be helpful for practitioners when it comes to understanding their own practice better to overcome obstacles and challenges.

The perspective developed in this study centres the attention on dynamics between, on the one hand, what the teacher is trying to achieve and, on the other, what is feasible given the particular circumstances. This study has shown how these dynamics played out as an ongoing intricate interweaving of artefact-mediated action into the conditions offered by the situation, and how it was through such active interaction with the external environment that the teachers were attempting to satisfy their motive-orientations. The study thereby exemplifies that in order to be able to study the dynamics of what makes certain courses of action practical it is helpful to conceptualise the physical and cultural environment as being *in relation to* the internal cognitive processing of the teacher. The findings exemplify how the inclusion of both the internal psychological and external practical dimensions of in-the-moment decision-making allows for analysis of their intricate interaction and mutual constitution.

8.3 The Use of External Artefacts Is Part of What It Takes to Teach

The findings contribute beyond the specific domain of teacher decision-making because they are relevant to a closely related topic about what teachers need to be able to teach. Different strands of literature have explicated what teachers draw on in order to be able to do their teaching, often with the goal to understand how to prepare teachers. The findings presented in this thesis highlight the importance of including a focus on artefact use in such discussion. As will be argued in the following, the contribution of attending to artefact use lies in the possibilities for being specific about the external supports that enactment of teaching requires, thereby offering a micro-level lens on practical aspects of what it takes to teach.

As mentioned in the introduction chapter, Doyle's (Doyle & Ponder, 1977) work on the practicalities of teaching has been an important inspiration in the development of this research project, and his concept of student tasks (Doyle & Carter, 1984) was helpful in refining the conceptual model developed in the data analysis. As noted in chapter six, this study followed Doyle's (2006) own suggestion to integrate the ecological perspective with conceptual resources from cultural-historical research traditions. By focusing on the use of artefacts, and by conceptualising these in relation to teachers' perspectives and pursuits of motive-orientations, the perspective developed in this thesis, however, arrives at a different view of the situational aspects of teaching than that of Doyle's ecological approach to the study of teaching (Doyle, 1977, 1983, 2006; Doyle & Carter, 1984). This difference is important to point out because it highlights how this study moves the discussion beyond a focus on constraints, a focus which has tended to be central in the ecological approach to research on teaching.

The emphasis on constraints stemming from physical and cultural circumstances is visible, for example, in Doyle's (1977) analysis of what he calls 'environmental demands'. Doyle includes the following features of classrooms under this category: '(a) multidimensionality; (b) simultaneity; and (c) unpredictability' (p. 52). In summarising the findings relating to 'multidimensionality', for example, Doyle highlights how 'dealing with one dimension (e.g., distributing resources and supplies) had consequences for other dimensions (e.g., managing classroom groups) and in the sense that procedures at one point established a precedent that restricted options at a later time' (p. 52).

Another example is Doyle's (1983) comparison between insights about optimal ways to structure intellectual demands of student tasks and research into the realities of classroom teaching. Doyle's argument is that we need to acknowledge and be realistic about the circumstances that classroom teaching introduces: 'Whatever alternatives are proposed for classrooms, the need to manage groups of students through time and space and the ambiguity and risk associated with academic tasks remain' (p. 187). While Doyle forcefully argues for the importance of considering the everyday ecologies of classrooms, the circumstances under which teachers operate are mainly considered as restrictive. Working from his starting point of merging insights about optimal tasks into classroom teaching, he puts forward a view where '(t)he central problem, then, is to find ways to make classrooms more productive in face of the realities that exist in such environments'.

The tendency to treat features of classroom environments as demands on teachers is also central in Doyle's (2006) more recent summary of the ecological approach to the study of classrooms. Reviewing the literature within the ecological perspective, he highlights the following features: multidimensionality, simultaneity,

immediacy, unpredictability, publicness and history. Instead of emphasising how these dimensions can provide *both* possibilities and constraints, as has been the approach in the study presented in this thesis, Doyle's emphasis remains on the ways such practical aspects of teaching situations create demands:

> 'All of these factors combine to create demands and pressures on participants as activities are played out in these environments. These demands and pressures are placed especially on teachers who carry professional adult responsibility for planning and monitoring classroom activities.' (Doyle, 2006, p. 99)

The findings presented in this thesis illustrate that a constraints-view of teaching situations runs the risk of only getting at half of the story about what it takes to enactment teaching decisions. From the perspective of the individual teacher the arrangements of the immediate physical and cultural setting also present opportunities for action. The intricate interweaving of artefact use into the specific situational circumstances that was found in this study is not adequately captured by describing only the limits that these circumstances put on decisions. The analyses undertaken in this research project have shown how the teachers *made use of* their environment to enact decisions. Zooming in on the micro-level unfolding of in-the-moment teacher decision-making provided a perspective where the arrangements of teaching situations helped just as much as they hindered the teachers' efforts to seek out artefacts and interweave them into the circumstances of their classrooms.

The discussion in the previous section has already included examples of research on teacher knowledge, highlighting how this rich body of research on what teachers need to know tends to focus elsewhere than the specifics of outward action and the physical and cultural teaching environment. In his often cited paper, Shulman (1986) suggested that research on teaching should learn from developments within cognitive

psychology and he set out a focus on knowledge, posing questions such as: 'What does a teacher know and when did he or she come to know it?' (p. 8). Shulman presented a distinction between knowledge about subject matter ('content knowledge'), knowledge about theories and methods of teaching ('pedagogical content knowledge'), and knowledge about the range of available options and material for teaching specific subject matter ('curricular knowledge'). To this three-way distinction between different knowledge domains, Shulman added a distinction between forms of representations that structure teacher knowledge, distinguishing between propositions, cases and strategies.

Mirroring Shulman's proposal, several other types of teacher knowledge have been proposed with the aim to capture the cognitive reasources that teachers bring to the complex task of teaching. These include 'practical knowledge' (Elbaz, 1983; Fenstermacher, 1994; Meijer, Verloop, & Beijaard, 2001), 'personal practical knowledge' (Clandinin, 1985; Connelly, Clandinin, & He, 1997; Golombek, 1998; Tsang, 2004); 'practical theories' (Buitink, 2009; Kettle & Sellars, 1996; Kroath, 1989) 'personal practical theories' (Cornett, Yeotis, & Terwilliger, 1990; Levin & He, 2008; Maaranen, Pitkäniemi, Stenberg, & Karlsson, 2016; Männikkö & Husu, 2019); 'action oriented knowledge' (Carter, 1990); 'craft knowledge' (Black-Hawkins & Florian, 2012; Brown & McIntyre, 1993; Leinhardt, 1990) and 'principal practical knowledge' (Bereiter, 2013, 2015).

As the names of these concepts suggest, there is a clear interest in explicating the knowledge involved in the doing of teaching, highlighted by the emphasis on 'practical', 'action oriented' and 'craft'. Enquiry into 'practical knowledge' has, for example, sought to unpack the cognition that is unique to individual teachers, specific to the context of the teacher's classroom, derived from direct experience, difficult to verbalise, related directly to the content of the particular subject and instrumental in

guiding teachers' practices (Meijer et al., 2001, p. 171). Similar to the above-mentioned definition from Winch, Oancea and Orchard (2015) of teacher knowledge as comprising 'situated understanding', 'technical knowledge' and 'critical reflection', researchers of practical knowledge have thereby sought to come close to the person-specific contextual realities of teaching by trying to capture a broad range of cognition that guides practice.

The study presented in this thesis has shared the aim to bring out the specifics of what teaching requires. It has demonstrated how dynamics underpinning the practical enactment of in-the-moment teaching decisions can be found in the specific and context-bound unfolding of teaching situations. The study presented in this thesis has demonstrated the importance of moment-by-moment use of artefacts for teachers' interweaving of decisions into the specific circumstances of classrooms. Making visible the instrumental role of artefact use, the study draws attention to the value of taking into consideration the concrete utterances, objects, writing, visual depictions, gestures and sounds by means of which teaching is achieved.

This study achieved detailed accounts of practical aspects of teaching by analysing decision-making at a high level of temporal granularity, unpacking artefact use action-by-action and operating at an analytical timescale which showed the development of teaching situations as a result of communicative interaction between teacher and students (Lemke, 2000). It was at this level of specificity that the functions of the case teachers' use of artefacts became visible. Without zooming in analytically, and without attending to differences between artefacts and between the timings of their use within the unfolding interaction, it would have been very difficult to account for, or even notice the functions of artefact use in resolutions to difficult teaching situations. Insights into the role of the availability of productive means were enabled by specifying the concrete artefacts that the teachers produced and the timing at which this was

possible. The importance of different points of communication became visible by comparing how and when different artefacts were communicated to the students. Analysing the temporal unfolding of strings of different artefacts furthermore made visible how the enactment of decisions continuously engaged with established expectations about task scripts and acceptable modes of communication, showing how the teachers strategically used artefacts to match as well as shift such expectations.

The specificity of the analysis which made the action-level dynamics visible showed to be a particular advantage of the attention to artefact use. As shown in this study, zooming in on micro-level dynamics of artefact use can open up the practical aspects of enacting teaching decisions. It opens up enquiry into phenomena that otherwise risks becoming closed off from further analysis if it is regarded as being too context-bound and situation-specific to yield to systematic examination. By analysing this phenomenon at the level of artefact use, it was possible bring out the workings of dynamics at play during in-the-moment decision-making while at the same time maintaining that each decision was highly situated.

By opening up the action-level enactment of in-the-moment teacher decision-making, this study's analysis of the functions and conditions of artefact use adds to existing perspectives available for the portrayal of classroom practices. The possibility for specificity in the analysis makes this study's artefact-perspective an important addition to existing concepts for unpacking the external doing of teaching. Such conceptualisations have tended to extend beyond individual actions, classifying types or groups of actions and responses. Helsing (2007, p. 1319), for example, has discussed different pedagogical responses from teachers faced with uncertainties or dilemmas, identifying characteristics pertaining to such responses, and including as positive responses 'investigation and experimentation with problems of practice' and as negative

responses 'compromised standards, reliance on routines, conservatism and conformity, blame' as well as behaviour that is 'inflexible, strained, uncreative and rigid'.

Another example of classification of teacher behaviours comes from Parsons et al.'s (2018) recent literature review on instructional adaptations. While their review provides a conceptualisation that is more specific than the evaluative characteristics provided by Helsing, Parsons et al.'s discussion still operates at the level of groups or types of actions. Bringing together a model of adaptive teaching, Parsons et al. provide the following typology of teacher responses: 'Questioning', 'Encouraging', 'Assessing', 'Modelling', 'Managing', 'Explaining', 'Guiding Feedback', 'Challenging' and 'Making Connections' (p. 231). Other examples of concepts for general typifications of teacher behaviour include 'core practices' (B. H. Dotger, 2015; Grossman, Hammerness, & McDonald, 2009), 'core practice frames' (Janssen, Westbroek, & Doyle, 2014) and 'operative systems' (S. Dotger & McQuitty, 2014).

Grouping teacher actions into typologies could potentially lead to new insights if combined with an analytical attention to teachers' use of artefacts. For example, future research could draw on Helsing's above-mentioned categories to examine differences in artefact use during experimentation and during rigid responses to teaching problems. In such enquiry, however, it would be the analysis of artefact use that would enable a level of analysis specific enough to get at dynamics relating to the action-by-action unfolding of the teachers' responses. Our understanding of what it takes to teach should be able to account for different levels of analysis, and this is also why future research could extend the findings of the present study by 'zooming out' more to compare different ways of using artefacts. However, if the focus remains only on more general categorisation of teacher behaviours, it diverts our attention away from the kind of dynamics that this study has illustrated to be important for teachers when it comes to making their

decisions practical within the physical and cultural circumstances of their classrooms. The suggestion provided on the basis of this study is that attention to artefact use enables new insight about moment-by-moment enactment of teaching because this fine-grained view allows both a temporal specificity and the possibility of being concrete about the actual tools of enactment (objects, writing, visual depictions, spoken language, gestures and sounds).

As a result of drawing on the cultural-historical idea of artefact mediation, the conceptual framework developed in this thesis provides a particular perspective on what it takes to teach, highlighting the coming together of internal psychological and external material aspects. By centring the account of teachers' enactment of decision-making around the cultural-historical concept of artefact mediation, the theoretical perspective developed in this thesis draws attention to the mutual constitution of internal psychological and external physical and cultural aspects of action. As discussed in the theory chapter, the focus on artefact mediation, the subjective perspective of teachers and the interaction between motive-orientations and artefact use provides a way to examine physical and cultural circumstances, without disconnecting that analysis from psychological processes.

The artefact-perspective highlights the use of artefacts as a 'bridge' between internal and external processes that play out in concert. While this study deliberately sought to pursue an alternative path than the dominant focus on internal psychological processes, the focus on artefact mediation has made it possible to avoid falling into the opposite camp, where teaching risks being portrayed only in terms of external behaviours, a danger which quickly arises in endeavours to classify and categorise teacher action through concepts like those mentioned above.

Among the concepts mentioned above, the notions of 'core practice frames' (Janssen et al., 2014) and 'operative systems' (S. Dotger & McQuitty, 2014) can be seen as attempts to mitigate the same conceptual challenge of bridging cognition and outward action. With their concept of core practice frames, Janssen et al. for example find a way to holistically capture teachers' visions and conceptions about how they would want a desired set of teaching practices to play out. Dotger and McQuitty, on the other hand, combine teachers' knowledge and 'the different practices they undertake in their teaching' (p. 77) into their concept of operative systems, mapping connections between different elements in individual teachers' operative systems.

However, compared to Janssen, Westbroek and Doyle's identification of core practice frames and Dotger and McQuitty's mapping of operative systems, the artefact mediation perspective developed in this thesis goes a step further because it reserves a particular role for artefact use when it comes to specifying the dynamics that fuse internal and external dimensions of action. Drawing on the cultural-historical research tradition described in the theory chapter, the dynamics through which psychological processes and external practical operations constitute one another are seen as mediated through the reliance on artefacts. These artefacts have histories and are configured physically in particular ways, making them useful for specific purposes if they are used in congruence with the physical and cultural circumstances of the immediate situation.

8.4 Implications for Practitioners

By emphasising the role of artefact use and by offering an alternative micro-level view of the practicalities of in-the-moment decision-making, this study opens up new ways to construe how to prepare teachers for dealing with challenging teaching situations. The

study contributes by laying out conceptual resources that may be helpful in practitioners' work because they make new opportunities visible. Attention to the micro-dynamics of artefact use presents an entry point into understanding the specific practicalities of challenging teaching situations. As will be suggested in this section, such micro-level focus on artefact use opens up ways to help teachers with aspects of in-the-moment decision-making that might otherwise be disregarded, either as being too context-bound to warrant careful consideration, or as a source of complexity that needs to be overcome through simplification of teaching procedures.

The practical aspects of teacher in-the-moment decision-making – the ways the physical and cultural arrangements make some courses of action easier than others – are pertinent to a range of practitioners who seek to support teachers. The topic is central to the preparation of teachers through initial and continuing teacher education, as well as to teachers who seek to address problems in their own practice. The topic also concerns developers of educational technology, school managers and those involved in the implementation of school change because these areas all engage with the physical and cultural circumstances that may enable and constrain teacher decision-making.

As pointed out in the introduction chapter, Doyle and Ponder (1977) have argued for the importance of attending to practicality when trying to understand teachers' responses to proposals of school change. Seeking to answer the question of what makes teachers perceive a change proposal as practical, Doyle and Ponder point to three aspects that were also mentioned in the introduction: instrumentality, congruence and cost. Their argument has been followed up by the suggestion that the design of educational innovation should try to systematically link innovations to teachers' practices (Janssen et al., 2013, pp. 36–37), stressing that designers of change need to recognise that 'rather than optimizing solutions, people use limited resources and

simplifications to achieve modifications that are "good enough" within given conditions', and that 'teachers need to design feasible procedures (instrumentality) that fit goals and circumstances (congruence) within the constraints of time and resources (costs)'.

Researchers studying the design of educational technology have also pointed to the importance of the topic of practicality. Naturally, these researchers have focused on uptake and use of educational software and devices, seeking to ensure a high level of usability. Some of this usability research has focused on the teachers (Heitink, Voogt, Verplanken, van Braak, & Fisser, 2016; Okumuş, Lewis, Wiebe, & Hollebrands, 2016). Usability has been explored for example by administering surveys to assess the reception of educational technology with items such as 'I find it easy to get the technology to do what I want it to do', thereby seeking to measure the 'learnability, functionality, navigation, and memorability' of technology, the 'users' perceived understanding, mental effort, ease of use, and flexibility of a given technology' and 'the degree to which the user believes using a specific technology will increase his or her job performance' (Holden & Rada, 2011, pp. 351–352). Other researchers have taken a different approach, studying the micro-level processes of using technological tools as an integral part of teaching, for example by studying the possibilities afforded by computers in the teaching of writing (Thompson, 2010), or for example by studying the role of interactive whiteboards in the development of dialogue-focused teaching strategies (Hennessy, Mercer, & Warwick, 2011; Mercer, Hennessy, & Warwick, 2010).

The topic of practicality is also a concern when dealing with questions that are relevant to school management. A key task for school principals is the coordination of teaching activities, which arguably involves working towards consensus about objectives and a sense of shared direction (Goldring & Pasternack, 1994). The

coordination of teaching activities is likely to necessitate a balancing between objectives and what is practically feasible for the teachers, if the shared objectives are to move beyond a 'sense' of direction and become realisable in everyday work. Furthermore, school management is usually largely responsible for the allocation of time and resources as well as the nature of teaching spaces and materials, factors which are likely to have direct bearings on what is practical for the individual teacher in the classroom.

Within the domains of teacher education and continuing professional development, a better understanding of the practicalities of teaching is also relevant to key concerns. A key concern in teacher education has been the linkage between theory and practice (Korthagen & Kessels, 1999). The problem is how to overcome a split between teachers' 'personal classroom experience' and ''propositional' knowledge derived from empirical and theoretical research in the foundation disciplines of education' (Burn & Mutton, 2015, p. 217). Some argue that teacher education research is currently moving towards focusing on teachers' practices and behaviours (Martin & Dismuke, 2018). However, the challenge for teacher educators of targeting the enactment of teaching has long been known, sometimes being referred to as the problem of enactment: 'Without a clear sense of how teachers' ideals translate into classroom behaviors, with multiple ideals influencing their interpretation of classroom situations, and with the vagaries of the language of classroom ideals, these teachers' interpretations of classroom situations, and their responses to them, will depend heavily on a frame of reference we may never see and they may never be aware of' (Kennedy, 1999, p. 70).

When teachers engage in the development of their own practice, this too will require a focus on the physical and cultural circumstances of their classrooms, taking practical issues into consideration when enquiring into problems of practice or when planning lessons. A focus on the constraints and possibilities of physical and cultural

circumstances may become relevant within shared inquiry activities among teachers, which have been argued to promote continuous professional learning and to enable teachers to develop local solutions to the complexities and uncertainties they face in their job (Hargreaves, 2003, p. 147). Such a focus may, for example, serve as an important point of attention during 'instructional rounds', which combine classroom observation, the development of an improvement strategy and the building of a network between educators (City, 2011). It may also be useful in 'lesson studies', where a prototype lesson is collaboratively planned, refined, tested and evaluated through peer-observation (Puchner & Taylor, 2006). Practical concerns will furthermore be important to any efforts to plan lessons, and the focus becomes particularly pertinent when teachers engage in intensive planning along the lines of what Stylianides and Stylianides (2014, p. 376) call instructional engineering:

> 'By an instructional engineering we mean a deliberately designed task sequence, together with carefully prepared teacher actions for implementing the task sequence in the classroom, all of which aim to steer student progression toward a particular learning goal while also placing decreased demands on the teacher for improvisation and in-the-moment decision making.'

It is important to stress that the present study does *not* offer particular ready-to-use strategies for any of these groups of practitioners. Across the domains of school change, educational technology, school management, teacher education and teachers' improvement of their own practices, the different groups of practitioners will be focusing on commitments that relate to their particular responsibilities and they will operate by devising very different initiatives and strategies. The developments of such new strategies will require continuous experimentation and evaluation. The findings of this study do, however, have implications for these groups of practitioners on a conceptual level. The findings have the potential to inspire and guide the developments

of new practices by drawing attention to the role of artefact use. As will be argued below, attention to teachers' interweaving of artefacts into the physical and cultural circumstances of teaching offers a level of specificity that is well suited for engagement with the practicalities of difficult teaching situations.

As shown in the findings chapters, and as highlighted earlier in this chapter, the dynamics involved in making the teachers' decisions practical were found at the micro-level of action-by-action interaction between teacher and students. Rather than merely pointing to the context-bound and situated nature of in-the-moment teacher decision-making, it was possible in this study to produce a conceptual model which captures congruence and incongruence that arise within the enactment of specific teaching decisions. As summarised in the conceptual model in Figure 5 on p. 232 in the beginning of this chapter, close attention to the role of artefacts made visible the importance of fit between teachers' outward actions; their assessment, specification and justification of student task components; and the circumstances that enable the teachers' in-the-moment production and communication of artefacts.

For practitioners, the concepts developed in this study hold the potential of guiding enquiry into situations of teacher decision-making, either through retrospective unpacking and reflection on specific situations teachers recurrently face, or through prospective assessment of whether anticipated situations are likely to make desired courses of action difficult for a particular group of teachers. In other words, for practitioners, this study offers conceptual tools for understanding teaching in a way that opens up a nuanced perspective on the practicalities of enacting in-the-moment teacher decisions. Importantly, the conceptual model does not portray teachers' enactment of decisions only as behaviours, which is a common pitfall when parsing the practice of teaching (Kennedy, 2016). Instead, the concepts developed in the study invite taking the

perspective of individual teachers, depicting their use of artefacts as an active interweaving with the situational circumstances through which they attempt to resolve the challenges they face. Rather than providing practitioners with lists of discrete teacher behaviours that should be promoted, the conceptual focus on the use of artefacts instead offers a framework for investigating teaching which maintains, as Kennedy recommends, a connection between visible teacher behaviours and 'the purposes that are served by those behaviors' (p. 6).

The findings of this study point towards two interrelated areas where the concepts about artefact use may help practitioners investigate and prepare teachers for in-the-moment decision-making. The first area lies in the potential of *noticing* artefact use. As van Es, Cashen, Barnhart and Auger (2017, p. 167) summarise, noticing is the 'ability to attend to noteworthy features of instruction, to reason about what is observed in meaningful ways, and to decide how to respond'. Importantly, as van Es et al. stress, the ability to notice 'involves acquiring tools and frameworks to help guide what to look for and how to characterize the work of teaching'. The focus on artefact use can bring aspects of teaching into view that might otherwise be overlooked, opening up possibilities for anticipation of micro-level dynamics that enable and constrain enactment of teacher decision-making.

The noticing of the role of artefact use could help guide what to focus on in teachers' observations and discussions of their own practice, including by building this focus into software that can facilitate teachers' handling of video-recorded teaching practices (Van Es & Sherin, 2002), or potentially by making this focus part of role-play activities designed for learning how to notice and act in-the-moment (Lajoie, 2018). Noticing of dynamics that enable and constrain teachers' artefact use will also potentially be beneficial to school managers, designers of educational technology and

implementers of school change because the success of these practitioners hinges at least partly on whether their initiatives are practical for teachers in their moment-to-moment work.

Both for the teachers themselves, and for practitioners engaged in supporting their work, noticing of the micro-level practicalities of in-the-moment decisions may be aided through the mapping of artefact use. Such mapping could, for example, be organised in terms of identifying the specific artefacts that an individual teacher used when responding to particular types of teaching challenges. Such maps of artefact use may become a useful resource, for example, for teachers who seek to address particular problems of practice. These maps may also serve as fine-grained data on challenges or situations that are important to the initiatives of school principals, software designers or administrators of school reform.

The value of mapping teacher artefact use is an area that remains to be explored, but in principle it offers the possibility of juxtaposing concrete components of teachers' enactment of teaching, providing a sense of the commonalities across different teachers' practices. It thereby opens up a concrete way to explore and identify key physical and cultural circumstances that are central to enabling and constraining enactment of particular teacher decisions. It would also make visible 'outliers' in the form of unusual uses of artefacts that may hinge on the presence of distinct circumstances and that might be developed further into new and alternative possibilities for action.

The second area that should be highlighted on the basis of the findings concerns the need for anticipatory *rearrangement* of physical and cultural circumstances. Rearrangement of circumstances will depend on the ability to notice the micro-level practicalities of teacher decision-making. However, while noticing concerns the understanding of practice that may bring new opportunities into view, efforts to support

teachers' in-the-moment decision-making will also require an active engagement with the available conditions. As the findings of this study have illustrated, enactment of teacher decision-making is enabled and constrained by circumstances that have come into place prior to the moment where the need for in-the-moment decision-making emerges in a specific lesson. Deliberate rearrangement of such circumstances should therefore take place before those brief moments where teachers are fully engaged and occupied with the resolution of specific challenges.

Considering the different enabling and constraining circumstances that were highlighted in this study, it is likely that some circumstances will be more difficult to rearrange than others. Making sure that the relevant productive means are available at the right moment is arguably the most straightforward aspect to rearrange. It will, however, put demands on the materials available in the classroom and the teachers' familiarity with the means available in the teaching space. It will require preparation of materials that can be brought to the classroom, and it will hinge on the extent to which teachers have control over what is available in the classroom (for example whether teachers have their 'own' classroom, a designated classroom for their specific subject, or whether they move between multiple teaching spaces).

Rearranging teaching spaces so that they offer new convenient points to communicate from may often be difficult to achieve, depending on the design of rooms, the available furniture and positions of boards, projectors and other equipment. For the individual teacher, some opportunities may be offered by moving around chairs and tables, walking between students and asking students to get up from their chairs, as seen in some of the examples presented in the findings chapters. Knowing such options for rearranging the classroom requires familiarity with the teaching space. Furthermore, efforts to change the layout of a classroom or the option of moving to an alternative

teaching space will often require considerable preparation. However, as seen in the example where the mathematics teacher Richard improvised breakout groups through the use of extra chalk blackboards on the side walls of the classroom, it is also likely that spaces can be rearranged to offer flexibility that is relevant to unanticipated teaching challenges.

As shown in the previous chapter, the case teachers relied in their decision-making on students' familiarity with task scripts as well as the modes of communication that were acceptable for them to use. Hinging heavily on the expectations of others, especially the students, and on cultural traditions in and beyond the school, practitioners' engagement with these cultural circumstances is likely to require considerable negotiation. The individual teacher is not alone in this process, especially as the conduct of other teachers in the same school is likely to shape students' expectations. However, a teacher such as Isabel was able to draw on considerable groundwork in her decision-making, including having familiarised students with a speaking-in-pairs task where students would stand in two big circles and move to switch partner, and including using the first weeks of the school year to establish expectations about the classroom interaction.

As exemplified in the previous chapter, there is an opportunity to deliberately build up students' familiarity with new task scripts that can then be drawn on during in-the-moment decision-making. Similarly, the need for actively changing students' understanding of existing task scripts may be anticipated and dealt with prior to a situation of in-the-moment decision-making, or the teacher may plan to have available artefacts that are useful in countering undesired student understandings. Focusing on the availability of acceptable modes of communication, there may also be ways for teachers to take note of the modes they tend to resort to, as well as ways to explore the

possibilities of alternative modes of communication. In particular, it becomes relevant to focus on the social positions the teacher builds up in relation to the students, considering the opportunities and constraints they afford when it comes to the fast-paced communication during in-the-moment decision-making. As already noted, deliberate rearrangement of such cultural circumstances will require negotiation over time, and it may depend on concerted effort across the school.

The conceptual framework developed in this thesis is relevant to practitioners as a means for guiding their reflective enquiry and active engagement with specific teaching practices because it draws attention to certain relationships that might otherwise be overlooked, and because it provides a systematic way to address the micro-level practicalities of the enactment of in-the-moment decisions. The specificity of the conceptual lens is key to making the perspective relevant to practitioners. It holds the potential of guiding the examination of practice onto a level of specificity that is particularly useful to practitioners, addressing pressing issues highlighted by Kennedy (2016, p. 6):

> 'One problem has been finding the right "grain size" for parsing teaching practice. If we break practice into very small bits, our lists become too long and our curriculum crowded with minutia. However, if the partitions are too large, we may have difficulty clarifying individual parts in a way that helps novices "see" them. Another problem has been making individual parts meaningful, once they are isolated from the rest of teaching. We may define a collection of discrete actions without attention to the role these actions play in context.'

The perspective developed in this thesis offers the potential for noticing the specifics of what makes in-the-moment decisions practical and it provides a way to guide deliberate rearrangements of circumstances for better accommodation of desirable practices. By offering a way to be specific about the practicalities of teacher decision-making, the focus on artefact use provides a middle ground between three problematic

extreme positions on how to deal with the highly situated nature of teaching. One of these extremes is the idea of wanting to avoid complexity by attempting to simplify teaching procedures and conditions. At another extreme, unreflective embracing of the context-bound qualities of teaching may lead to a sink-or-swim approach (Darling-Hammond, 1990) where learning the enactment of teaching decisions becomes restricted to trial or error, if the practical and situated specifics of teachers' everyday work are seen as being too varied to allow systematic preparation.

The third extreme is one that recognises the vital role of continuous reflection on practice, but which keeps discussions within the abstract with reference only to general principles about teaching, without analysing concrete details of examples from classrooms. Providing a way to steer between such extremes, by focusing on the specifics of artefact use in relation to the pursuit of challenging motive-orientations, the perspective developed in this study holds the potential of being particularly relevant to practitioners because it offers a way to parse practice at a useful level of detail, without disconnecting it from the intentions that motivates it.

9 Conclusion

This final chapter concludes the thesis by first summing up the contributions of the study. Because these contributions were discussed in detail the previous chapter, this chapter provides only a brief highlighting of the key points, after which the analytical approach of the study will be foregrounded as an important development in its own right. The latter part of the chapter considers the main limitations of the study and it draws out a number of future research possibilities that emerge from this theory development study.

Summary of key contributions

The first main contribution of the study is the development of the conceptual model presented in the previous chapter (see Figure 5 on p. 232). The model summarises the findings of the study in a holistic framework for understanding the role of artefact use during in-the-moment teacher decision-making and it outlines the relationships that were found to be important in making the enactment of decisions practical. As already emphasised, the extent to which the findings generalise beyond the five case teachers and the specific context of their school remains a question for future research. However, by explicating this conceptual model and its theoretical and empirical underpinnings, this study offers a coherent foundation for further systematic enquiry into the ways that in-the-moment teacher decisions are made congruent with the physical and cultural circumstances of specific teaching situations. The fine-grained analysis undertaken in this research project made visible that action-by-action use of artefacts was instrumental in the resolution to challenging teaching situations and that the reliance on concrete

external supports had to be interwoven into the distinct physical and cultural circumstances of the situation. As will be highlighted in the latter part of this conclusion chapter, the conceptual model provides a systematic outset for future research, presenting the possibility of systematically refining its propositions and giving the basis for noticing and addressing new questions.

The study furthermore contributes by illustrating how there is an alternative to the tendency to focus only on psychological dimensions of teacher decision-making. By focusing on artefact use, and by coupling the analysis with attention to the perspective and motive-orientations of individual teachers, this study has exposed the need to include external dimensions into the discussion, and it has opened up possibilities for new insights about the intricate mutual constitution of inner psychological and outer practical aspects. The study has shown the value of including concepts that reserve space in the analysis for components that cannot be fully addressed in accounts of psychological processes. This has been highlighted by making visible how dynamics relating to the practicality of teacher decisions were found at a highly detailed level of analysis, unpacking moment-by-moment classroom interaction at a level of specificity where the teachers' engagement with their environments would have been very difficult to capture if relying only on psychological constructs. By offering an account of teacher decision-making that includes its external dimensions, this study has opened up enquiry into the ways enactment of in-the-moment decisions is accomplished through action-by-action use and reconfiguration of the external environment, relying on the opportunities the environment offers while keeping to the artefact use it allows.

Beyond the specific topic of in-the-moment teacher decision-making, this study moreover draws attention to the ways in which artefact use is an important part of what it takes to teach. The study explicates a view of the role of teachers' immediate teaching

situations which focuses not only on how classroom arrangements constrain teaching. Offering an analysis of the ways teachers make use of their environments, the study showed how situational circumstances presented both barriers and possibilities for teachers' moment-by-moment building of courses of action. Adding to efforts to understand the practical doing of teaching, the focus on artefact use offers a way to be specific about what it takes to enact teaching decisions, specific both temporally and in terms of being concrete about observable aspects of teaching. By focusing on the use of artefacts, the perspective allows a fine-grained view that avoids a behaviouristic disregard of psychological processes. It does so by including attention to the motive-orientations of individual teachers and by drawing the analytical lens towards artefact use as a crucial point of interchange in the mutual constitution of internal and external dimensions of teaching.

Lastly, as discussed in the previous chapter, the conceptualisation developed in this thesis can become helpful to practitioners in construing ways to support in-the-moment teacher decision-making. It offers a systematic way to examine the micro-level practicalities of enacting teaching decisions. It can provide a lens for engaging with issues that otherwise might be overlooked because they are playing out at a level that is sometimes considered too situation-specific to allow systematic enquiry. As a lens for examining specific teaching practices, the concepts developed in this thesis hold the potential for helping practitioners notice possibilities and constraints that might not otherwise come into view, offering a basis for deliberate rearrangement of specific teaching situations to better accommodate new courses of action.

A new analytical approach for studying in-the-moment decision-making

The development of this study's analytical approach was pivotal for understanding the role of external supports during in-the-moment teacher decision-making, and it offers an approach whereby observational data can be unpacked in future research to further improve our understanding of this topic. The analytical approach therefore deserves a brief mention before moving on to consider the limitations of the study as well as the future research possibilities that emerges from it.

The development of the analytical approach was the result of attempting an alternative route of enquiry, observing the need for explicating the role of the tools by means of which teachers enact decisions. Tailoring the methodological approach specifically to the object of inquiry, while at the same time developing the conceptualisation of the phenomenon, meant that it was possible to achieve consistency between topic, theory and methods. The approach is in itself a contribution because it can be replicated in the study of new cases and because it would be useful in guiding studies that adopt alternative designs or ask different questions about the topic, as will be highlighted in the latter part of this chapter. In other words, the approach developed here offers something which was unavailable when this study began: a method for studying the external dimensions of in-the-moment teacher decision-making.

The pursuit of an adequate method led to the development of an approach which zoomed in on the micro-level dynamics of instances of in-the-moment teacher decision-making, using detailed data about the teachers and instances in the form of observations, post-lesson interviews and documents. As described in the methods chapter, the approach developed in this study draws on the idea of 'zooming in' from micro-process studies of teachers' work (Little, 2012). The overall strategy of the study shares Little's (2012, p. 143) emphasis on the importance of 'investigations of what teachers and

others actually do'. As Little argues, 'it seems unlikely that a robust understanding of practice can be achieved absent the strategic use of methods that capture the detail, nuance, and patterning of social interaction' (p. 146). As Little stresses, 'zooming in' on micro-processes helps enable 'a deeper understanding of the practices and perspectives in play in specific moments (events, activities)' (p. 160). The idea is that 'close attention to patterns of on-the-ground interaction' provides the basis for 'zooming out' to understand the origins and consequences of the observed patterns, offering also the opportunity to imagine new ways to prepare and respond to such patterns.

In-depth analysis of the cases at the micro-level of interaction was a key strength of the approach that was developed in this research project. It allowed an action-by-action analysis of the enactment of decisions, enabling an unpacking of how the teachers relied on strings of multiple artefacts and how each of these artefacts became operational by being woven into the specific circumstances of the situation. Without the micro-level focus that the analytical approach enables, these dynamics would have been overlooked.

A key aspect of the zooming in on micro-level dynamics was the focus on difficult teaching incidents. As shown in the methods chapter, these instances provided a robust unit of analysis in the analytical work to understand the case teachers' in-the-moment decision-making. Focusing on these embedded units of analysis was natural because they provided specific examples of the phenomenon of interest, and the data collection and analysis could therefore be organised around understanding these instances in-depth. As described in the methods chapter, the embedded design had three levels: the school, the teachers and the instances of in-the-moment decision-making. The three levels were seen as 'embedded' into one another, the levels being integral parts that could only be separated analytically with continuous attention to the whole

system (Sawyer, 2002). Careful conceptualisation of the different levels in the case study design helped ensure that the zooming in on instances did not compromise a holistic understanding of each case.

While the retrospective accounts from the post-lesson interviews provided invaluable information, the focus in this study on the *enactment* of decisions made it particularly important to have data on the actions of the teachers. Through the reliance on observations as the main source of data, the approach taken in this study diverts from the tendency in micro-process studies to zoom in on instances using audio-recorded teacher discourse (Hall & Horn, 2012; Horn, 2005, 2007, 2010; Horn & Kane, 2015; Horn & Little, 2010; Little & Horn, 2007). By going beyond the emphasis on talk, the approach developed in this study was able to open up and explore questions about the range of supports teachers use, spanning different modalities and including writing, visual depictions, sounds, gestures and objects.

The analysis of teachers' use of external supports was enabled by coupling the micro-process approach with analytical procedures developed from the cultural-historical method of double stimulation. The adaptation of the method of double stimulation is particularly useful for the study of this topic because it allows action-by-action identification of the external artefacts that a teacher uses in a given situation, while at the same time including into the analysis the particular subjective perspective of that teacher. Capturing a teacher's contribution to a challenging teaching situation as goal-directed behaviour, and systematically unpacking moment-by-moment shifts in motive-orientations, the developed adaptation of the method of double stimulation uniquely enables analysis of the coming together of teachers' shifts in course of action and the artefacts they use to enact those shifts.

The analytic procedures that were detailed in the methods chapter contributes by offering a systematic adaptation of the double stimulation approach for the study of in situ processes. Instead of relying on researcher intervention, this study offers a systematic approach for identifying the first stimulus (motive-orientations) and second stimulus (artefacts) through the analysis of observations and interviews. By drawing on Hedegaard's (2008a, 2008b, 2012a, 2012b) research on motive-orientations and her principles for analysis of observation data, the study offers systematic analytical procedures for capturing the interplay between shifting intentions and the use of external artefacts. The resulting analytical approach for unpacking instances of teacher decision-making revolved around the analytical table which was detailed in the methods chapter. Because this table and the analytical procedures it systematises are built around the concepts developed in this study, these analytical procedures supplement the conceptual contribution, offering a way to render the topic open to further study in future research.

Limitations and future research possibilities

The first limitation that needs highlighting concerns the level of detail achieved in the lesson observations. While the observations were found to be sufficiently detailed for the purposes of this theory elaboration study, an important direction for future research lies in the advantages of using video recording. On the basis of the conceptual work undertaken in the present study, future research could use video recording to achieve an even greater level of detail in data on in-the-moment decision-making as it unfolds in the classroom. In particular, video would make possible a more precise characterisation of each artefact (for instance a teacher's writing on the board). Furthermore, video recording would allow stronger inferential leverage when it comes to ruling out whether

specific artefacts were used or not. Moreover, it would afford opportunities to use video recordings as a focal point for interviews with teachers, thereby including the teachers themselves in the identification of the supports they used. While video recording would have limited the breadth of data in this study, as noted in the methods chapter, this study's conceptual developments and analyses offer a useful framework for guiding future video-based enquiry.

Another limitation, which has already been stressed several times and which was discussed in the methods chapter, concerns the extent to which findings from this study can be generalised. The aim of this project was to enable analytic generalisation rather than statistical generalisation. The strategy was hence to build the foundation for generalisation by formulating concepts which can then be drawn on, challenged and refined in future analysis of new cases. To strengthen the potential for future use of the concepts that were developed in this project, this thesis has sought to be transparent about the relationship between concepts and observations in the data, presenting a detailed account of the systematic analytical procedures on which this relationship was established, and by explicating the broader theoretical roots of the proposed concepts.

A third limitation relates to the low number of teachers who participated in this study. Although the five case teachers were chosen to ensure maximum variation between them (in selecting teachers from different subjects and with different amounts of teaching experience), they were all from the same secondary school in England. This study does not claim to have outlined all the possible ways to use artefacts during in-the-moment teacher decision-making. Including more teachers from different context would help to better cover further variation in how schoolteachers use external supports to resolve challenging teaching situations.

By providing in-depth analysis of a low number of cases, the aim in this theory elaboration study was to build a conceptual basis from which new cases can be studied in the future. This research project, however, started without such conceptual basis and this study was therefore unable to select teachers according to theoretically relevant differences. As will be highlighted below, such theoretically guided design of contrasts between cases is one of the future research possibilities enabled by the conceptual framework that was developed in this study.

Being a theory development study which started broad, it is natural and desirable that this study concludes by producing new questions. Because the present study opens up a new topic, deliberately shifting the focus to an understudied aspect of teacher decision-making, the findings and the methodological approach bring out several areas that require future research. Further enquiry into the topic could, as discussed earlier in this chapter, draw on the analytical procedures that were developed in this research project. Building on the groundwork undertaken in this study, future research could furthermore benefit from strategic comparison of cases and from reliance of different types data. Video recordings would, as already discussed, enable detailed data on instances of decision-making. Surveys or diary study methods could help increase the number of research participants, providing a better understanding of differences between teachers as well as changes over time. Intervention studies or experiments would provide a better understanding of the directionality of conceptual relationships, and would be particularly useful in testing the theoretical concepts developed in this study.

Future study and development of practices in this area could potentially benefit from opening up the conversation beyond the teaching profession, considering the findings of this study in relation to other types of workplaces and jobs. Future research

may find ways to bring into the conversation insights from domains such as those of the medical, military, engineering, business, accounting and law professions. Platforms for such trans-profession discussion and theory development may be found beyond the educational research literatures, for example within the disciplines of organisational psychology and organisation studies.

An important area for future research lies in the potential of differentiating between different types of artefacts and different types of in-the-moment decisions. Thereby, future studies can build on and add nuances to the holistic perspective developed in this research project. A particularly promising direction for such more narrow-focused research is the potential of mapping artefacts according to specific teaching challenges. Teaching challenges may, for example, be differentiated according to subjects and research could target frequently occurring issues relating to students' understanding of specific subject matter. There may also be logistical challenges that cut across subjects where the mapping of different relevant strings of artefacts could help specify different possible courses of actions for teachers in such situations. Practicing teachers could be involved directly in such mapping of artefact use, whereby a great level detail could be achieved. If the artefacts can be meaningfully mapped, familiarity with such maps of external supports would also, as suggested in the previous chapter, offer new ways for teachers to prepare for in-the-moment decision-making.

By making visible how in-the-moment teacher decision-making has an external practical dimension, the findings of this study diverts from other accounts in the literature on teacher decision-making. The study shows a need to move the discussion beyond cognitive or psychological processes. It opens up a new conversation that includes the physical and cultural dimensions of enacting decisions. The importance of avoiding a disconnect between inner and outer has been emphasised throughout the

thesis, and, as detailed in the theory chapter, it was a key reason for the reliance on theoretical resources from cultural-historical perspectives. The approach that was developed in this study made it possible to connect the analysis of the use of external supports to internal psychological processes by focusing on the perspective of the teachers, in particular by relying on the concepts of artefact mediation and object-motives.

A further potential for future enquiry lies in understanding how the use of external supports relates to existing insights in the research literature about the psychological processes underpinning teacher decision-making, for example by examining interactions between teacher knowledge and artefact use. Such work would require conceptual developments because concepts such as 'practical knowledge' are not necessarily immediately compatible with the cultural-historical framework about artefact use. However, examining the relationship between teacher knowledge and artefact use holds the potential of bringing closer together cognitive and external aspects of teacher decision-making. It would also potentially make it possible to connect findings from the rich body of research on teacher knowledge to the further exploration of the practical aspects of artefact use.

While the study of teacher knowledge takes up a central role, researchers of teaching have also looked at psychological processes beyond teacher knowledge. Engagement with concepts such as beliefs (Fang, 1996), values (Campbell, Kyriakides, Muijs, & Robinson, 2004), visions (Duffy, 2002), goals (Schoenfeld, 2011) and identity (C. Beauchamp & Thomas, 2009) has extended our understanding of what is takes to teach. Considering the central role of artefact use during decision-making that was found in the present study, it seems likely that the ways teachers use artefacts interact with psychological components such as beliefs, values, identity, visions and goals. A

focus on artefact use holds the promise of bringing out how such general psychological characteristics links to the micro-level of teachers' actions in the classroom. Recognising the role of artefact use may therefore be particularly helpful to researchers that seek to relate psychological characteristics to the specifics of practice, for example through the study of the relationship between teacher beliefs and behaviours (Muijs & Reynolds, 2012), the role of visions in instructional adaptions (Vaughn, 2015), the importance of goals in teacher decision-making (Schoenfeld, 2011), the place of values in practice-level reconciliation of political demands (Jonasson, Mäkitalo, & Nielsen, 2015) and the intersections and possible conflicts between teacher identity and practice (Enyedy, Goldberg, & Welsh, 2005).

In the present study, the focus on teachers' perspectives and their motive-orientations highlighted the close relationship between their enactments of decisions and reconfigurations of the student tasks. The findings showed that the teachers' use of external supports during their enactment of in-the-moment decisions shaped the unfolding of students' learning activities. However, the relationship between the teachers' use of external supports and student learning remains to be explored. Building on the present study, future research should seek to address the question about student learning: what is the relationship between teachers' use of artefacts during in-the-moment decision-making and the learning of the students?

Conceptually, engagement with the topic of student learning fits well with the framework that was developed in this study. As detailed in the theory chapter and emphasised throughout the thesis, the teachers' use of artefacts were seen as tools for steering student participation, drawing on Wertsch's (2007) idea of explicit mediation. This attention to the 'tools' that teachers use to guide students may help further the kind of work undertaken by researchers who have drawn on cultural-historical research

traditions to study student learning, focusing for example on teachers' assistance of students' performance (Tharp & Gallimore, 1988), on teachers and students' co-creation of zones of proximal development (Thompson, 2012) and on the educational functions of teacher-student talk (Mercer & Howe, 2012).

Another question which this research project opens up, but which it did not address, concerns the professional learning of the teachers: how do teachers come to learn the ways they use artefacts in their enactment of in-the-moment decisions? The perspective on the use of artefacts that was developed in this study could help guide such further enquiry, exploring how and why teachers change their use of artefacts over time. Building on the findings of this study, a longitudinal dimension would allow examination of the ways teachers come to use some external supports and not others, and how they might go about changing the ways they enact in-the-moment decisions. Such line of research would have to follow not only individual teachers, but also how their teaching situations change, considering the findings from this study about the pivotal role of situational circumstances in enabling and constraining artefact use. This is an area where intervention designs would become particularly relevant, experimenting with different ways to help teachers learn to respond to challenging teaching situations in new ways.

Future research would be able to examine new opportunities for supporting teachers' engagement with difficult teaching situations by studying teachers' noticing of artefact use. Questions about noticing include whether teachers can learn to become more aware of the external supports they employ; whether they can train their abilities to see different possibilities for artefact use; and whether they can predict and plan around possible obstacles to their artefact use.

Future research could also examine how attention to the use of external artefacts can help teachers and other practitioners to deliberately rearrange the circumstances that enable and constrain in-the-moment teacher decision-making. Focusing on the strings of artefacts that a teacher would potentially need in a given situation may allow for action-specific ways to prepare for responsive teaching. Mapping out potential uses of strings of artefacts and trying to prepare the physical and cultural arrangements to accommodate them would offer an enactment-oriented type of contingency planning, which would be helpful especially when it comes to challenges that teachers recurrently face and wish to deal with differently. Questions about planning for responsiveness will also concern organisational levels: what might school management and other structural stakeholders do to provide physical and cultural circumstances that match or allow sufficient flexibility for desired enactments of in-the-moment teacher decisions?

While the move towards studying the micro-level intricacies of the external dimensions of challenging teaching situations is helpful in making visible new ways of supporting teachers, this study is a first step. Projections about possible implications for practitioners will need to be followed up with further empirical study as well as experimentation with new practices. Such future empirical research has to go hand in hand with the actual devising of new strategies and technologies for supporting teachers, experimenting with their implementation and evaluating the bearings of such initiatives on in-the-moment teacher decision-making.

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11 Appendices

11.1 Limits Used in the Database Searches

Table 19: Limits Used to Narrow the Search of the Five Databases to Studies on Teaching

Database	**Limits**
ERIC	The search was limited to articles categorised under the ERIC subject classification 'Teaching methods'.
British Education Index	No limits were used to focus the search on teaching methods.
Web of Science	The search of the Web of Science Core Collection was limited to the research area 'Education Educational Research'. Furthermore, hits were removed on the basis of journal titles, excluding hits from journals that did not directly cover school education.
Scopus	The search was limited to articles categorised under the Scopus keywords 'Teaching' and 'Education'.
PsycINFO	The search was limited to articles categorised under the following PsycINFO classification codes: '3530 Curriculum & Programs & Teaching Methods' and '3560 Classroom Dynamics & Student Adjustment & Attitudes'

11.2 CUREC Approval Letter and Application

CUREC approval letter

From: **Jenni Ingram** jenni.ingram@education.ox.ac.uk
Subject: CUREC Approval
Date: 7 Aug 2015 11:30
To: Kasper Munk kasper.munk@gtc.ox.ac.uk
Cc: Education Research Office research.office@education.ox.ac.uk, Ian Thompson ian.thompson@education.ox.ac.uk

JI

Date 7th August 2015

Dear Kasper

Application Approval

Title: Teachers learning from collaboration

The above application has been considered on behalf of the Departmental Research Ethics Committee (DREC) in accordance with the procedures laid down by the University for ethical approval of all research involving human participants.

I am pleased to inform you that, on the basis of the information provided to DREC, the proposed research has been judged as meeting appropriate ethical standards, and accordingly, approval has been granted.

If your research involves participants whose ability to give free and informed consent is in question (this includes those under 18 and vulnerable adults), then it is advisable to read the following NSPCC professional reporting requirements for cases of suspected abuse
http://www.nspcc.org.uk/globalassets/documents/information-service/factsheet-child-abuse-reporting-requirements-professionals.pdf
Should there be any subsequent changes to the project which raise ethical issues not covered in the original application you should submit details to research.office@education.ox.ac.uk for consideration.

Good luck with your research study.

Yours sincerely,

Jenni

Dr Jenni Ingram
Member of DREC
Associate Professor of Education (Mathematics)
Fellow of Linacre College
University of Oxford
Department of Education
15 Norham Gardens
Oxford
OX2 6PY

CUREC application

University of Oxford
CENTRAL UNIVERSITY RESEARCH ETHICS COMMITTEE (CUREC)
CUREC /1A CHECKLIST FOR THE SOCIAL SCIENCES AND HUMANITIES

The University of Oxford places a high value on the knowledge, expertise, and integrity of its members and their ability to conduct research to high standards of scholarship and ethics. The research ethics clearance procedures have been established to ensure that the University is meeting its obligations as a responsible institution. They start from the presumption that all members of the University will take their responsibilities and obligations seriously and will ensure that their research on human subjects is conducted according to the established principles and good practice in their fields and in accordance, where appropriate, with legal requirements. Since the requirements of research ethics review will vary from field to field and from project to project, the University accepts that different guidelines and procedures will be appropriate. Please check the CUREC website to ensure that you have the correct checklist for your project.

ONLY TYPE-WRITTEN CHECKLISTS WILL BE ACCEPTED. PLEASE DO NOT SEND HANDWRITTEN CHECKLISTS.

ONLY EMAILED APPLICATIONS WILL BE ACCEPTED. PLEASE DO NOT SEND APPLICATIONS BY POST.

What this checklist will not assess

This checklist does not cover research governance, satisfactory methodology, or compliance with the requirements of publishers when administering their tests or questionnaires. As principal researcher, it is your responsibility to ensure that requirements in these areas are met.

CUREC does not review studies classed as *audit* (see glossary and Decision Flowchart for CUREC on our website).

The use of an *asterisked word underlined* in this checklist indicates a phrase defined in CUREC's glossary. The glossary and further information on the University's research ethics procedures are available from the CUREC website: http://www.admin.ox.ac.uk/curec/

What this checklist is designed for

This CUREC /1A checklist is designed largely for research that falls within the Divisions of Social Sciences and Humanities where ethical issues are relatively few and straightforward. Interviews, field work and oral history are also included in the CUREC process.

The full CUREC /2 application is only required where certain project characteristics (eg type of participants, or procedures) result in a more complex set of ethical issues. It is expected that only in a limited number of cases will it be necessary for researchers to complete a CUREC /2 application. The checklist below will direct you to a CUREC /2 application if needed.

Office use only: IDREC Ref. No. _____

Date of confirmation that checklist accepted on behalf of IDREC: // //

Please complete the sections that follow and follow prompts to stop completion and/or submit other documents. ***Please indicate your answer to all the Yes / No questions with a type-written "X".***		
Example: ***1) By taking part in the research, will participants be at serious risk of criminal prosecution (e.g. by providing information on drug abuse or child abuse)?***	**YES** 	**NO** **X**

SECTION A: filter for CUREC2 application.

This section determines whether your study raises more complex issues which require the completion of a full application for ethical review, known as the CUREC /2 application.		
1) Are research participants classed as "*people whose ability to give free and informed consent is in question*"? (This may include those under 18 (though see FAQ C12), prisoners or vulnerable adults) *Note: sometimes participants aged 16-17 are regarded as "competent youths" and may be able to consent for research themselves. Please consult the FAQ C12 on the CUREC website. However, if any of your participants are aged 16 or under, please answer 'yes' here and also answer question 4) below.*	**YES** **X**	**NO**
2) By taking part in the research, will participants be at serious risk of criminal prosecution (e.g. by providing information on drug abuse or child abuse)?	**YES** 	**NO** **X**
3). Does the research involve the *deception* of participants?	**YES** 	**NO** **X**
If you answered NO to all of the questions above please go to SECTION B. If you have answered yes to any question above continue to question 4 below.		
4) Is your project covered by one of our approved research protocol(s)? (see CUREC website) If yes, please give protocol number(s): Protocol 15, i.e. '*Teachers, teaching in educational settings, typically-developing students*'	**YES** **X**	**NO**
If you answered Yes to ANY of questions 1-3, and answered No to question 4, please STOP COMPLETING THIS CHECKLIST and do not submit it for ethical review. ***Instead, please complete the CUREC/2 application form, available to download from the CUREC website. Then submit the CUREC/2 for ethical review.*** ***If you answered Yes to ANY of questions 1-3, and answered yes to question 4, please go on to SECTION B.***		

SECTION B: contact details and project description (NB must be typed not handwritten).

Contact details	
1) *Principal researcher* / supervisor (if student research):	Dr Ian Thompson
2) Name of student (if student research):	Kasper Munk
3) Degree programme, eg DPhil, BA, MPhil, BSc, MSc (if student research):	DPhil
4) Department or institute name:	Department of Education
5) Address for correspondence (if different from 4):	N/A
6) University email address and phone contact:	Kasper.Munk@education.ox.ac.uk +44 (0)7546653358 (UK) +45 51845143 (Denmark)
7) Name and status of others taking part in the project. Eg 3rd year undergraduate; post-doctoral research assistant:	N/A

Project description	
8) Title of research project:	Teachers learning from collaboration
9) List of locations(s) where project will be conducted:	An English secondary school, Oxford, UK A Danish school, students' age 6-18, Copenhagen area, Denmark[3]
10) If your research involves overseas travel or fieldwork, by the time the research starts, will you have completed and returned a travel risk assessment form? (This may be necessary to ensure that the activity is covered by the University's travel insurance – see http://www.admin.ox.ac.uk/finance/insurance/travel/)	Yes
11) Anticipated duration of project:	__26__ months
12) Anticipated start date:	20 / 8 / 2015
13) Anticipated end date:	31 / 9 / 2017 (planned DPhil thesis submission date)

[3] In the early phase of the research project, when this CUREC application was made, the plan was to compare between two settings; between a school in England and a school in Denmark. This comparative aspect was, however, abandoned to enable more extensive data collection and more in-depth data analysis within one setting. The methods chapter discusses this strategy in section 4.2 about case selection.

14) Title and brief lay description of *research* (about 150 words), plus description (about 200 words) of the nature of participants.

When describing the research, please include your methodology, how you are applying professional guidelines, and the use to which results/data will be put. Please also declare any conflicts of interest here.

When describing participants, please include criteria for inclusion/exclusion, method of recruitment, and processes (as appropriate) for consent to participate. To support your description please attach documentation such as:

- recruitment and advertisement material eg a poster or invitation letter
- information for participants to read before they agree to take part eg participant information sheet(s)
- a document to record informed consent eg written consent form(s) or oral consent script in case of an oral consent process
- a guide to interview questions (this may be a list of questions to be asked, or a preliminary scope of questions) or sample of other instruments such as a sample questionnaire
- debriefing document after participants have taken part (if relevant)

Detailed guidance is found on the CUREC website

Title and brief lay description of research (150 words)

'Teachers learning from collaboration'

This study examines how secondary school teachers use collaborative reflection with colleagues to find new ways of teaching. In each of the case-schools, the researcher (Kasper Munk) conducts non-participant observations and audio- and video recordings[4] of teacher group meetings. Furthermore, individual teachers' are followed using non-participant observations of their everyday work activities (e.g. teaching lessons, preparation, other meetings, breaks). Selected teaching sessions are audio recorded (using a lapel microphone) and video recorded (camera pointing at the teacher). Interviews are conducted with teachers and school management **(see appendix for interview schedules)**. Documents about the schools as well as documents and artefacts (e.g. teaching materials) used by the participating teachers will be collected, either in paper form or by photographing these (making sure that the photo or video captures only of the document or artefact avoiding any individuals in the picture).

Description of participants and obtaining informed consent (200 words)

This study examines teachers' professional learning and focuses solely on the participating teachers and not the students. Adopting research protocol 15, informed consent from the head teacher and participating teachers will be obtained **(see appendix for information letters and consent form).**

Following protocol 15, and because the study uses video-recording of the teacher in the classroom, students and parents will be informed and provided the opportunity to opt-out **(see appendix for information letter for students and parents and opt-out form)**. When video recording the selected teaching sessions, the camera will point at the teacher. Deliberate filming of student's faces will be avoided. Images of students accidentally captured will not be reproduced or used for research purposes.

[4] The CUREC application included the possibility of using video-recording in case the use of that data collection method would become relevant.

15) What are the ethical issues connected with your research and what steps have you taken to address them?

Please do not answer "none".

The committee wants to see evidence that you have identified potential ethical issues with respect to your research and have taken steps to address them. These issues could relate to your own safety as a researcher, participant burdens/risks, and data protection/confidentiality. For more guidance on ethical issues, please see http://www.admin.ox.ac.uk/curec/resources/.

Names of students and non-participating staff in the collected data

Names of students and/or staff members not participating in the study may appear in the collected data (e.g. a name mentioned in teachers' group discussion or in an interview). Such information will be coded by the researcher without using any of such names or identifiable features (e.g. job titles).

16) Will you obtain informed consent according to CUREC guidelines and good practice in your discipline before participation?	**YES**	**NO**
	X	
If you have marked No, please give a brief explanation and justification for this decision here:		

17) Will your research involve discussing sensitive issues? This could be information relating to race or ethnic origin, political opinions, religious beliefs, physical/mental health, trade union membership, sexual life or criminal activities.	**YES**	**NO**
If you have marked Yes, please make sure that you have included some supporting information (as directed in question 14 of this section) showing the range of questions covering these issues.		**X**

18) Will you ensure that *personal data* collected directly from participants or via a *third party* is held and processed in accordance with the provisions of the Data Protection Act?	**YES**	**NO**
	X	

19) How will you ensure that any personal or sensitive data are captured, transferred and stored securely?

In particular if data are to be captured electronically, please consult with your local IT department and, with respect to University IT security policies, please comment on how you will capture such data in the first instance, how you will transfer them over networks or via portable media and how and where data will be stored. For more information please see the University's web pages on research data management:
http://researchdata.ox.ac.uk/university-of-oxford-policy-on-the-management-of-research-data-and-records/

Field notes from observations, audio files, photos, videos, digital documents and any transcriptions will be stored on the researcher's password protected computer and backed up using Oxford University's secure HFS backup service. Only password secure USB keys will be used to transfer files. Any field notes on paper or other paper based data (e.g. documents from the school) will be stored in a locked cupboard in the researcher's lockable office.

SECTION C: methods and procedures to be used.

In this section, please mark X against as many methods or procedures as apply to your research. (This section will help the committee understand the nature of your research and may be used for audit).

	Please mark "X"
1) Analysis of existing records	
2) Snowball sampling (recruiting through contacts of existing participants)	
3) Use of casual or local workers eg interpreters	
4) Participant observation	
5) Covert observation	
6) Observation of specific organisational practices	X
7) Participant completes questionnaire in hard copy	
8) Participant completes online questionnaire or other online task	
9) Using social media	
10) Participant performs paper and pencil task	
11) Participant performs verbal or aural task (eg for linguistic study)	
12) Focus group	X
13) Interview	X
14) Audio recording of participant	X
15) Video recording of participant	X
16) Photography of participant	
Others (please specify):	

SECTION D: professional guidelines and training.

In this section, please mark X against at least one of the following professional guidelines. You should use the principles listed in your chosen guideline(s) in conducting your own research. Note this is not an exhaustive list.

Research specialism/methodology	**Association and guidance document (active links below)**	**Please mark "X"**
Anthropology	Association of Social Anthropologists of the UK and	

	Commonwealth	
Criminology	British Society of Criminology: Code of Ethics for Researchers in the Field of Criminology	
Education	British Educational Research Association Ethical Guidelines for Educational Research	X
Geography	Association of American Geographers Statement on Professional Ethics	
Geography	Royal Geographical Society: Research Ethics and Code of Practice	
History	Oral History Society of the UK Ethical Guidelines	
Law (Socio-Legal)	Socio-Legal Studies Association: Statement of Principles of Ethical Research	
Management	Academy of Management's Professional Code of Ethics	
Political Science	American Political Science Association (APSA) Guide to Professional Ethics in Political Science	
Politics	Political Studies Association. Guidelines for Good Professional Conduct	
Psychology	British Psychological Society Code of Ethics and Conduct British Psychological Society: Conducting Research on the Internet: (Guidelines for internet-mediated research)	
Social Research	Social Research Association: Ethical Guidelines	
Sociology	The British Sociological Association: Statement of Ethical Practice	
Visual Research	ESRC National Centre for Research Methods Review Paper: Visual Ethics: Ethical Issues in Visual Research	
Other professional guidelines ***Please specify the other guideline(s) used here:***		

Please indicate what training in research ethics the researchers involved with this study have received, e.g. the title of the course and date completed (online training available at http://www.admin.ox.ac.uk/curec/training/)

If no formal training has been received, please indicate any discussions of research methodology between researchers and supervisors here.

'Mastering the Art of Ethics Applications', Social Science Division, University of Oxford Kate Sahan, 27th October 2014.

'Research ethics and risk assessment', Research Training Seminar, Department of Education, University of Oxford, Dr. Susan James Relly, 16th October 2014.

'Ethics and legislation', 12 weeks course with exam, Department of Psychology, University of Copenhagen, Prof. Jacob Dahl Rendtorff and Prof. Erik Lohmann-Davidsen, Spring 2011.

SECTION E: Signatures.
Please ensure* this *checklist is signed by:

For staff research:	*For student research:*
1) *Principal researcher*	**1) *Principal researcher* (project supervisor)**
2) Head of Department (or nominee)	**2) Head of Department (or nominee)**
-	**3) Student researcher**

1) Principal researcher signature / supervisor signature (if student research)

I understand my responsibilities as *principal researcher* as outlined in the CUREC glossary and guidance on the CUREC website.

I declare that the answers above accurately describe the research as presently designed and that a new checklist will be submitted should the research design change in a way which would alter any of the above responses so as to require completion of CUREC/2 (involving full scrutiny by an IDREC). I will inform the relevant IDREC if I cease to be the principal researcher on this project and supply the name and contact details of my successor if appropriate.

Signed by principal researcher / supervisor: ……

Print name (block capitals) ……

Date ……

2) Departmental endorsement signature

I have read the research project application named above. On the basis of the information available to me, I:

(i) consider the *principal researcher* and student researcher (if applicable) to be aware of their ethical responsibilities in regard to this research;

(ii) consider that any ethical issues raised have been satisfactorily resolved or are covered by relevant professional guidelines and/or CUREC approved protocols, and that it is appropriate for the research to proceed (noting the principal researcher's obligation to report should the design of the research change in a way which would alter any of the above responses so as to require completion of a CUREC/2 full application);

(iii) am satisfied that: the proposed project design and scientific methodology is sound; the project has been/will be subject to appropriate *peer review*; and is likely to contribute to existing knowledge and/or to the education and training of the researcher(s) and that it is in the *public interest*.

Signed by Head of Department or nominee: ……

(example nominees for student research include the Director of Graduate Studies / Director of Undergraduate Studies)

Print name (block capitals) ……

Date: ……

3) Student signature (if student research)

I understand the questions and answers that have been entered above describing the research, and I will ensure that my practice in this research complies with these answers, subject to any modifications made by the principal researcher properly authorised by the CUREC system.

Signed by student: ……  …..

Print name (block capitals) …KASPER MUNK…..

Date: ……14th July 2015……..

SECTION F: final check before submitting your application.

	Please mark "X"
Have you completed Sections A-E?	**X**
Have you included copies of any documentation produced with your application? ***If the appropriate supporting documentation is not included with your application, you will then be asked to provide this separately. This may well delay the ethical review process, and thus the start of your research.***	**X**
Have you signed as principal researcher and gathered signatures of the student (for student research) and department nominees as appropriate?	**X**
Have you declared conflicts of interest (if any) in Section B question 14?	**X**
Are all pages (including supporting document attachments) numbered?	**X**
Have you defined all technical terms and abbreviations used?	**X**

How to submit the completed checklist

- ***If your department has a Departmental Research Ethics Committee (DREC), submit this checklist and supporting information to the appropriate departmental officer. To see a list of DRECs, go to www.admin.ox.ac.uk/curec/about/sshidrec/drecs/***
- ***If your department does not have a DREC, submit the checklist and supporting information to the SSH IDREC (email ethics@socsci.ox.ac.uk). NB applications must be sent by email. Please do not send applications by post.***

Note on how to send signatures needed in Section E

- ***If you have obtained handwritten (wet-ink) signatures, please scan them plus the rest of the checklist pages to create a single PDF document and email through.***
- ***Alternatively, we accept "electronic signatures" sent as email confirmations from a University of Oxford email address. Separate emails should come from each of the relevant signatories as outlined in Section E, indicating acceptance of the relevant responsibilities.***

IDRECs and/or CUREC will review a sample of completed checklists and may ask for further details of any project.

11.3 An Example of Observation Notes

Data excerpt 1 in the methods chapter showed a section of a written-up observation. Data excerpt 3 below is included to show the observation notes that were written in the classroom during the same five minutes (including typos, abbreviations, etc.), allowing thereby for comparison between observation notes and final written-up observation.

Data excerpt 3: Example of observation notes, notes from the same five minutes of Richard's year 10 maths lesson as the written-up observation in Data excerpt 1.

> "Divide your sins. That is what they told me when I went to [name of school]. St. Were you at
>
> I can get rid of my sins, I am forgiven! (arms out and smiling
>
> R calculating through
>
> R: what does it come up with? St. error. R: error. R: have you all
>
> R. as a little side note, you don't have to all write this down.
>
> Just do 10-1 on you calculator, prove that it is one tenth.
>
> Do that on your calculator, to show you can do it. make sure that your calculators are all in degree smode. Your calculators mush be in degrees mode.
>
> R: then have a look at question 4
>
> R. and in order to motivate you, I am going to put on some motivational music.
>
> studetn in th ebck: It makes me wanna cry. stu: you are so negative today."
>
> (Richard, observation notes)

11.4 An Example of the Analytical Table Analysis

The analytical table was described in the data analysis section of the methods chapter. In the methods chapter, the analytical procedures and each of the table's columns were illustrated by providing an example of one row from an analytical table analysis. An example of a full analytical table analysis is included below in Table 20, showing the action-by-action unfolding and analysis of a full instance of in-the-moment decision-making. Table 20 contains the analysis of the instance that was also drawn on for illustration in the methods chapter, an instance where the science teacher Michael experienced the following challenge: 'Am I doing something wrong that causes the students to misbehave?' The analytical table is presented across the following six pages.

Table 20: Illustration of a Full-Length Analytical Table Analysis

#	A. Teacher's actions	B. Other relevant data	C. Teacher's goals	D. Student actions	E. Teacher's motive-orientations	F. Artefacts used by the teacher
1.	Michael says after a minute (Michael hasn't addressed the whole class before this and most of the students have been sitting down for at least 1 minute): "Where can I see people doing the starter?" One student: But what is the starter? Michael has put a picture of a thistle-looking flower on the slide and points to it. The slide does not have any text. Michael says: Why do you think I have put this picture on there (or similar formulation, as presenting this question as the starter)?	"Ehm, hectic as in their behaviour wasn't great coming in and then throughout it was just hard work consistently." "The challenge was to capture their imagination in the first place. Which I thought I failed." "I think it easier just to say, if I did it again, I'd structure the starter better, I'd include a video for that group, of different seeds on Youtube and visualise it, I might make a template of a big, a medium and small one. So that they can make the choice as a preliminary experiment. And then, so they have got a basis for changing the other variables, so I would probably scaffold it more."	Draw the students' attention to the starter task and encouraging them to think about the pictures on the slide.	One student asks what the starter task is.	1. Capture students' imagination and introduce the students to the topic of the lesson.	Michael: "Where can I see people doing the starter?" The PowerPoint slide with the picture of the flower. Michael: Why do you think I have put this picture on there.
2.	Michael says that he is going to wait – looking around (i.e. going to wait to there are less noise, some students are talking or calling/shouting out noises). (at least 5 times there is noicse, banging on table, student talking out loud). Michael: don't make noises.		Wants the students be quiet.	Some students are talking or calling/shouting out or making noises.	2. Avoid that students are talking, moving around and making noises.	Says that he is going to wait. Gaze (looking around the room). Michael: Don't make noises.
3.	Michael ask about why he may have put that slide on. One student with his hand up is picked by Michael and the boy says: Is it about harvesting? Michael says that it is not quite, rather we are in the other end of the circle (i.e. of the plant process, meaning seeds).		Have students think about the pictures on the slide and what the topic of the lesson is.	One student says: Is it about harvesting?	1. Capture students' imagination and introduce the students to the topic of the lesson.	Question about why he may have put that slide on. Student's hand up. Michael says: It is not quite, rather we are in the other end of the circle (i.e. of the plant process, meaning seeds).
4.	Another student says: Are we learning about dead (not sure that I heard this) plants? Michael says no.			Student giving suggestion about what they are learning about.	1. Capture students' imagination and introduce the students to the topic of the lesson.	The word "no".

5.	Michael: I am waiting (referring to the level of noise/activity in the classroom).		Wants student to be quiet.	-	2. Avoid that students are talking, moving around and making noises.	The phrase "I am waiting".
6.	Michael says about a new slide: all three are types of seeds. The slide has three pictures, one of them being deflowered dandelion and two other pictures of deflowered flowers.		Connect the the pictures of deflowered flowers to the idea of seeds.	-	1. Capture students' imagination and introduce the students to the topic of the lesson.	New slide with three pictures of withered flowers. Michael: All three are types seeds.
7.	Michael shows the 'helicopter' made of paper by letting it fall down. Not all of the students are looking up when Michael lets it fall. Maybe half of them are. One student says: sick (this student is the only one saying something in response to what Michael did).	"I think it is a bad example of a lesson really, because it had already had anything taken away from it, I didn't use PowerPoint, I, I didn't use computers, I didn't really use anything apart from me and writing on the board so it was fairly back to basics anyway. In terms of planning it, I mean, if I didn't have materials for them to use that would obviously a major issue so, I needed to make a model of it myself, but yeah."	Demonstrate how the helicopter falls.	Not all of the students are looking up when Michael lets it fall. Maybe half of them are. One student says: sick (this student is the only one saying something in response to what Michael did).	1. Capture students' imagination and introduce the students to the topic of the lesson.	The paper helicopter.
8.	Michael shows picture of strawberry on the slide (seeds are very visible, large picture). Four students yell: Strawberry! (at the sight of the slide).		Show another type of seeds.	Four students yell: Strawberry! (at the sight of the slide).	1. Capture students' imagination and introduce the students to the topic of the lesson.	Picture on slide of strawberry.
9.	Michael asks how they do (i.e. with the seeds)		Draw students' attention to the distribution of seeds.	-	1. Capture students' imagination and introduce the students to the topic of the lesson.	Question: How do they do?
10.	One student yells out: You eat them! Michael says: And stop (as in stop talking/shouting answers). Michael "we will not except our learning and our progression of the lesson to be slowed down by (...)" (i.e. noise/interruptions/ students talking).	"Slow to get started, ehm, a bit hectic, but I think it leaves us in a reasonable place for next lesson."	Emphasise a rule for students' behaviour.	One student yells out: You eat them!	2. Avoid that students are talking, moving around or making noises. 3. Accept no disruption and	The word "stop". Verbal formulation of a rule about the activity as a whole (no slowing down).

					slowing down of the lesson and students' learning.	
11.	Michael asks a question about the seeds and a lot of students start talking.		Have students think about seeds.	A lot of students start talking.	1. Capture students' imagination and introduce the students to the topic of the lesson.	Question about the seeds
12.	Michael asks one student to come (...I am not sure: I think to come to sit somewhere else or similar).		Ensure less talk among the students and less noise.	One student moves to sit somewhere else (I think)	2. Avoid that students are talking, moving around and making noises. 3. Accept no disruption and slowing down of the lesson and students' learning.	Instruction for one student to sit somewhere else.
13.	Michael asks the class: "What are the seeds? Why are they adapted to have these functions? Third student answering (picked with hand up), student saying: Are they trying to get some where else. Michael: Exactly.		Have students think about the function of the differences between seeds. Making clear that the students' answer was hitting the right way of thinking (cf. "Exactly").	Third student answering (picked with hand up), student saying: Are they trying to get some where else.	1. Capture students' imagination and introduce the students to the topic of the lesson.	Question: What are the seeds? Question: Why are they adapted to have these functions? Students' hands up Evaluation of students answer: "Exactly".
14.	A boy making sounds. Michael says something about the noise. Michael: Sorry there is about four of you. Michael says that two boys need to leave the classroom. Michael: (name of boy), you. The boy: Sir, you didn't give me a final reminder. You give me detention. The boy sitting next to the boy says: It was me. The boy that has been given detention says 4 times:	"Challenge is to get them through the instructions so they can actually start enjoying the activity in which we lost a couple of people to excluding them for poor behaviour." "They went to another science room where there is a sixth form class going on. They would have sat there doing work from a textbook."	Avoid interruptions and enforcing the rule he emphasised above. Counter the boy's resistance to	A boy making sounds. The one boy resists being sent out, complaining that Michael is always picking on him,	2. Avoid that students are talking, moving around and making noises. 3. Accept no disruption and slowing down of the	Warning or note about behaviour. Michael: Sorry there is about four of you. Order to leave the classroom.

	it wasn't me. The boys says out in a loud voice (sounding very displeased): "Why are you always picking on me! You are sending me out!" Michael: Clearly not, I am sending you out without a final reminder, but I am sending you out. The boy gets his stuff and walks towards the door, still saying things about it being unfair. The other boy that was sent out already stand in the front of the classroom door with his jacket on (this boy is not the one that said ' it was me').	"We have got a rota so every lesson we know, if we need someone, send someone out that will be where we send them." "Mmmh, it is in the department handbook."	leaving the room.	emphasising that he did not do anything wrong. The other boy gets up and goes to the door, ready to leave the room.	lesson and students' learning.	Michael: Clearly not, I am sending you out without a final reminder, but I am sending you out.
15.	There is an extra teacher sitting in the left of the room between two students that she has been talking to occasionally.		-	-	-	-
16.	Michael to the class: I am commenting on these groups of children (Michael pointing, Michael saying something more referring to that these two that were sent out but that it could also be others. Michael: "Not letting some immature boy" ruin it for everyone else (or different formulation). Michael: "There are concequences boys, it is just not" okay/good enough. Michael says that if "you carry on" you're are going to do book work and detention. Michael: "It's not working."		Emphasising that there are consequences of poor behaviour and point out that especially the boys should consider this. Give reason for his approach to poor behaviour (cf. "It's not working.")	-	2. Avoid that students are talking, moving around and making noises. 3. Accept no disruption and slowing down of the lesson and students' learning.	Warning about behaviour. Formulation of general rule for how the lesson will run. Threat/warning with appeal to the procedures of detention and book work.

17.	Michael takes the paper helicopter, stands on a chair and drops from the height of the ceiling. Michael: What can we measure. Two students: Time. Michael: Time is probably a good idea.	"So I decided that for three lessons I was gonna do a helicopter, see (them) investigation about four days ago. So, I always knew that this lessons was gonna be about planning it, about setting it up, so then, earlier today got out post-it note and decided that I'd use seeds to introduce it, so I had a few pictures for them to look at and ehm, and I knew that I'd, I wrote down that I wanted to get their aim, for them to consider the variables, write a prediction and then be ready to start the investigation next lesson. So I had a sense of what I wanted to achieve out of it and I did that earlier today." "Framework of how I want an investigation to run, I have done a number of times with that class in terms of title aim, predictions, methods, things like that. So that is, I guess, the type of support. I nicked the idea from a colleague of the investigation, so that is another kind of support." "No, no, its, I have never done this investigation before so it is simply new to me." "I think it easier just to say, if I did it again, I'd structure the starter better, I'd include a video for that group, of different seeds on Youtube and visualise it, I might make a template of a big, a medium and small one. So that they can make the choice as a preliminary experiment. And then, so they have got a basis for changing the other variables, so I would probably scaffold it more."	Show how the helicopter falls and introduces it as object they can measure.	Two students say: Time.	4. Introducing the students to the task of making a prototype, specify aim, variables and predictions.	Paper helicopter. Michael: What can we measure. Evaluation of students' answers: Time is probably a good idea.

18.	Michael: That is called an outcome variable. Michael: I want you to begin to think, how can we change the speed. Michael writing on the board: 'Seed practical. Aim: Investigate factors effecting... (...some more writing on the board)'.		Introducing the notion of outcome variable and introducing the students' task experimenting with speed by which the paper helicopter falls.	-	4. Introducing the students to the task of making a prototype, specify aim, variables and predictions.	Michael: That is called an outcome variable. Michael: I want you to begin to think, how can we change the speed. Writing on the board: 'Seed practical. Aim: Investigate factors effecting... (...some more writing on the board)'.
19.	Michael (in response to something happen in the classroom): "If you are going to act like that, I will send you out, no matter I haven't given you a final reminder. I will give you this as a final reminder, if you are going to take it like (name of student that complained)."	"Hectic because we had to sit in seven different groups all of whom I gave the freedom to choose a subtly different investigation so, there had a lot of choices to make about the size of the helicopter but also the variable they are affecting so. Couldn't really stay in control of it, you had to give them the opportunity to run with it."	Give warning that poor behaviour will result in being sent out.	-	2. Avoid that students are talking, moving around and making noises. 3. Accept no disruption and slowing down of the lesson and students' learning.	Warning/threat concerning student behaviour. Clarification about the procedure of detention/sending out (here without 'final reminder') Use of previous situation as example, i.e. example of what will happen.
20.	Michael is writing on the board.		Providing students with information.	-	4. Introducing the students to the task of making a prototype, specify aim, variables and predictions.	Writing on the board.