A Mechanism Approach to the Sociology of Teachers' and Students' Actions:

Teaching Practice, Student Disengagement and Instructional Materials

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In 2004 the University of Gothenburg established the Centre for Educational Science and Teacher Research (CUL). CUL aims to promote and support research and third-cycle studies linked to the teaching profession and the teacher training program. The graduate school is an interfaculty initiative carried out jointly by the Faculties involved in the teacher training program at the University of Gothenburg and in cooperation with municipalities, school governing bodies and university colleges.
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Abstract

Title:	A Mechanism Approach to the Sociology of Teachers' and Students' Actions – Teaching Practice, Student Disengagement and Instructional Materials
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The overall purpose of this dissertation is to describe and explain teachers' and students' actions related to instruction in compulsory education classrooms in Sweden.

In order to approach these issues, I will focus on social mechanisms (processes) that can explain teachers' and students' actions in the classroom. I argue that such mechanisms and actions in schools have been sparsely studied in previous research.

Study I deals with the research question, Why does the teaching practice of individual work and class teaching occur in Swedish classrooms? **Study II** deals with the research question, Why does usage of instructional materials (whiteboards, laptops, paper-based materials, textbooks) vary across Swedish classrooms? **Study III** deals with the research question, Why does student behavioral disengagement occur and reoccur in Swedish classrooms? **Study IV** deals with the research question, Why and how do students' expectations about school, teacher–student relations, students' commitment to school, and truancy mediate the effects of student social background on mathematics achievement across Swedish schools?

For the first three studies, I used video data that I analyzed using multiple methods such as descriptive statistics, cox regression, field notes, transcripts, and pictures. In **Study IV**, I used secondary data from OECD[1] analyzed with structural equation modelling (SEM). In **Studies I** and **II**, the school class was the unit of analysis. In **Studies III** and **IV**, the individual student was the unit of analysis.

Study I indicates the increasing individualization of teaching. Furthermore, **Study I** indicates that subject area predicts teaching practice. **Study II** indicates that teachers use text-based materials more than textbooks or laptops. The study also suggests that class size affects students' usage of instructional materials in teaching

[1] Organisation for Economic Co-operation and Development

practice, as do school subjects. **Study III** indicates that peer encouragement and school subject can predict student behavioral disengagement. **Study IV** indicates that the relationship between student background and mathematics achievement is mediated by school expectations, truancy, and commitment. Moreover, I also identify an independent indirect effect of the teacher–student relationship on the average predicted mathematics achievement.

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Introduction

Two interrelated tendencies in Swedish education are of importance as a backdrop for this dissertation. The first is that teaching has become more individualized and less focused on textbooks and traditional lecturing. The second is that students' behavioral disengagement has become an increasing problem. These two changes in Swedish classrooms may in fact both be seen as part of one general trend, since they coincide with a general shift in educational values from the 1970s onward—that is, a shift from teacher-centered to student-centered teaching. Even though this is an international trend (Bromley, Meyer, & Ramirez, 2011), it seems that these values have a particular stronghold in the Nordic countries (i.e., in Denmark, Norway, and Sweden; (Blossing, Imsen, & Moos, 2014).

This dissertation is an attempt to describe and explain what is actually going on in some Swedish classrooms in connection to the two tendencies mentioned above: How are teachers teaching, and why?; and When do students disengage in class and why? In order to approach these issues, I will focus on social mechanisms that explain teachers' and students' actions in the classroom. The concept of "social mechanisms" here refers to processes that bring about teacher and student actions such as: organizing lessons in the form of lecturing, seatwork, and group work; using textbooks, whiteboards, and computers; and committing to homework or disengaging in class.

I argue that such mechanisms and actions in schools have been sparsely studied in previous research. Therefore, this dissertation makes a theoretical and empirical contribution to our current understanding of what happens in the classroom, and thus also to our understanding of the two general tendencies mentioned above.

Why Study Teaching Practices and Behavioral Disengagement?

There is a tendency in Swedish schools in which teachers allocate less time to class teaching and the use of textbooks than they have previously done. In the 1970s, Swedish teaching was more collective than today—that is, the teacher stood in front of the class and lectured at the whiteboard or had the students recite from a textbook. Textbooks were officially sanctioned up to 1991, when the national control of textbooks was abolished, a change that forestalled Sweden's transition from one being of the most regulated school systems to being one of most deregulated systems (Wilkins, 2011). Publishers now competed in a market by selling textbooks and other instructional materials to municipalities, school leaders, and teachers, and the publishers were free to create different instructional materials without restrictions to the curriculum or syllabus content (Beach & Player-Koro, 2012; Wilkins, 2011). With the development of computer technology

and new pedagogic ideals, however, policymakers expected teachers to move away from textbooks and embrace computer-based education. The reason is that instead of spending money on textbooks, the government (municipalities) invested financial resources in computer-based education. Paradoxically, Swedish teachers today largely use paper-based instructional materials and work sheets that they (re-)produce themselves, rather than textbooks or computers (National Teacher Union, 2014).[2]

This change in instructional materials is not as strange as it may seem, since it is part of a more general individualizing tendency within Swedish teaching. Swedish students today seem to spend the most time working individually in the classroom—more so compared to the other Nordic societies (Carlgren, Klette, Mýrdal, Schnack, & Simola, 2006). Consequently, teachers today spend more time in one-on-one interactions with students than on teaching the class collectively.

These changes indicate that teachers individually and as a profession exercise the power to choose how to teach and what instructional materials to use.[3] And their choices of instructional materials matter, because instructional materials expose students to common and structured curricular content (Stevenson & Baker, 1991; Stevenson, Schiller, & Schneider, 1994). Hence, the time spent on content coverage provides students with structured opportunities for learning curricular standards: internationally, time with textbooks still remains one of the strongest indicators of standardized curriculum content exposure (Valverde, Bianchi, & Wolfe, 2002) compared to other instructional materials.

Furthermore, choices of teaching practices matter, because they indicate how teachers, both individually and as a profession, exercise the power to choose the way teaching gets done (Ingersoll, 1996). Such teaching practice also indicates to what extent students are exposed to individual or collective teaching. Choices of teaching practices also matter, since students benefit differently from different types of teaching, depending on their race/ethnicity (Diamond, 2007; Dreeben & Gamoran, 1986) and social class (Gamoran & Nystrand, 1991).

Since these choices of instructional materials and teaching practices are of importance for students' learning opportunities, these are the main teacher actions that I will study in this dissertation. But teachers are not the only ones who act within the context of the classroom. Students' actions are also of great importance for understanding what happens in the classroom and why. The main kind of student action I will focus on is action related to behavioral disengagement. Lack of behavioral engagement among students not only has consequences for teachers, since teachers cannot instruct if the students do not committ to the instruction (Coleman, 1994); lack of behavioral engagement may also have consequences for students' participation in school, their higher education, their working life, and their connection with voluntary associations (e.g., sports

[2] The same pattern was found in a government report of English teachers (Oates, 2014). The report went as far as suggesting that England's fall in mean literacy and numeracy (compared to the OECD mean) was due to the dominance of "work sheets".

[3] "Power" in this sense can be defined as exercising control over the rights to resources or an event of interest to others (Coleman, 1994, p. 58). As I will describe later, teachers' power—as a profession—largely depends on student cooperation. This means a transfer of rights to higher-tier actions and hence increased trust (Coleman, 1994, p. 136).

clubs, political parties), since teachers' fostering of behavioral engagement (e.g., arriving on time, commitment to homework, attentiveness, etc.) may later generalize to civic engagement (Durkheim, 1925).

According to Statistics Sweden, 44% of the student in grade 4 witness acts of behavioral disengagement in the classroom on a daily basis (Statistics Sweden, 2012). At the same time, OECD suggested that Swedish students now top the PISA in late arrivals (OECD, 2013).[4] The Swedish School Inspectorate (2016) reported that about 1,700 students were repeatedly truant from school for a whole month. It is no wonder that bad working conditions for both teachers and students are one of the consequences of such behavioral disengagement. The Swedish Teacher Union, for example, suggested that the hard working conditions and the increased work hazards of teachers could partially be attributed to students' behavioral disengagement (Dagens Nyheter, 2014).[5]

By studying teacher and student actions, I want to shift what previous studies have used as their main dependent variables. Previous sociological educational research has studied test scores, marks, and enrollment in higher education as the main dependent variables. Such dependent variables are important, because a person's level of education has consequences for a person's future employment status (Blossfeld & Shavit, 2010), income (Gregorio & Lee, 2002), and health status (Torssander & Erikson, 2010). In studying these dependent variables (marks, test scores, enrollment), sociological educational research can explore social inequalities. Inequalities may be predicted by explanatory variables on the individual level, for example social class (Jackson, Erikson, Goldthorpe, & Yaish, 2007), sex (Buchmann, DiPrete, & McDaniel, 2008), and ethnicity (Kao & Thompson, 2003). Alternatively, inequalities may be predicted by variables at the contextual level, for example ability grouping and curriculum standardization (e.g., centralized testing, assessment, grading; (Van de Werfhorst & Mijs, 2010).

However, previous sociological educational research has devoted less attention to teachers' and students' actions as the main dependent variables (Bæck, 2011; Ramirez, 2006). The limited attention to teachers' and students' actions means that sociologists seem to neglect the study of actions that provide insights into the process of the main activity of schools, namely classroom instruction (Luhmann & Schorr, 2000; Vanderstraeten, 2001). Actions related to classroom instruction have important consequences for how schools foster civic values as well as behavioral and cognitive skills. These, in turn, are important for how schools contribute to social welfare.

[4] Program for International Student Assessment (PISA) is an international comparative study of students that enables comparison between OECD economies concerning 15-year-old students' ability to read as well as their numeric and scientific reasoning. At the start of PISA in 2000, Swedish students were top-ranked among the participating OECD economies. However, in PISA 2012, Swedish students performed under the OECD average for the second time.

[5] The Swedish Teacher Union is a governmental organization that evaluates Swedish schools.

Purpose and Research Questions

The overall *purpose* of this dissertation is to describe and explain teachers' and students' actions related to instruction in compulsory education classrooms in Sweden.[6] This aim can be broken down into four research questions, each of which corresponds to one empirical study in this dissertation. Two of these questions are more focused on teachers' actions, and two are more focused on students' actions; however, there is a strong connection between them.

Teachers' actions. The first two questions correspond to the problem of changes in teaching actions. Teaching actions relate to how teacher work coordinates students' work in the classroom. Thus, teaching actions are considered as joint actions between the teacher and the student, as I will discuss later in the framework section.

1. *How and why does the teaching practice of individual work and class teaching occur and vary across Swedish classrooms?* (**Study I**)

More specifically, *teaching practice* is defined as a joint type of action, such as recitation, lecturing, seatwork, group work, outdoors teaching, presenting, video watching, and transitions. I will describe the distribution of such teaching practices and explain how they vary with respect to subject area due to the mechanism of collegial influence.

2. *How and why does usage of instructional materials vary across Swedish classrooms?* (**Study II**)

Usage of instructional materials is defined as actions such as using textbooks, paper-based materials, laptops, or whiteboards. In other words, instructional materials are physical objects used to teach the curriculum. I will describe how teachers and students use instructional materials and explain why usage of instructional materials varies due to the mechanisms of collegial influence and time allocation.

Students' actions. The following two questions focus on students' actions and the problem of behavioral disengagement. Accordingly, students' actions are studied on the level of the individual.

3. *Why does student disengagement occur and reoccur in Swedish classrooms?* (**Study III**)

Student disengagement is defined as actions such as late arrivals, not paying attention in class, not bringing instructional materials to class, toying with classroom equipment, mocking the teacher, and interrupting the teacher. In other words, student disengagement includes actions that provoke the teacher. I will describe

[6] I use "action" instead of "social action" because the *social* seems superfluous and sometimes leads to definitions of action that conflate *action* with the *causes of action*.

student disengagement and explain why students disengage. Moreover, I will identify the effects of peer encouragement and the school subject.

4. *Why and how do students' expectations about school, teacher–student relations, students' commitment to school, and truancy mediate the effects of student social background on mathematics achievement across Swedish schools*? (**Study IV**)

Truancy refers here to the actions of skipping class or arriving late, and *commitment* denotes preparation for tests, attentiveness, completion of homework, etc. *Expectations* denote students' attitudes toward the outcome of grades and school work. *Teacher–student relations* denote the students' attitudes toward the teacher. *Social background* denotes immigration and socioeconomic status. *Mathematical achievement* refers to the PISA numeracy scores. In this study, I study how four mechanisms mediate the effects of student background on mathematical achievement: school commitment, truancy, school expectations, and teacher–student relations.

The main contribution of these studies is to provide a sociological explanation in response to each of the four questions. Sociological explanations are not descriptions, typologies, or conceptual frameworks but rather statements that identify underlining processes.[7] The two concepts *actions* and *mechanisms* serve as the common denominators for these studies, which makes it possible to articulate a joint purpose for all four studies in this thesis, namely to describe and explain actions in classroom teaching. This is an important thing to do, since most previous research has attempted either to describe teaching or to explain school outcomes without clarifying the mechanisms that are at play in the classroom.

The structure of this introduction is as follows. First, I outline the two key concepts of the dissertation: actions and mechanisms. Second, I discuss these concepts in previous research concerning classroom research. Third, I discuss the quantitative and qualitative methods used. Fourth, I discuss the studies in the dissertation. Fifth, I present the conclusions of the study as well as their social and practical significance. Finally, I provide a summary in Swedish.

[7] Even so, descriptions, typologies, and frameworks are necessary—but not sufficient—for deriving explanations (Gerring, 2012).

Analytical Framework

In this section, I will define the key concepts of the four studies in my dissertation: *action* and *mechanism*. The concept of action is used in all four studies as the dependent variable. Social mechanisms are used as the explanatory variable in all studies.

The framework of my dissertation can be summarized in the two following points:

- First, I chose explanatory research questions, and not only descriptive research questions (see **Purpose and Research Questions**). Here, I argue the need for mechanism-based explanations (see **Social Mechanisms**) of the effects of actions (see **Actions**). My framework resembles that of analytical sociology, because mechanisms and actions are at the core of analytical sociology (Hedström, 2005).
- Second, I focus on the difficulty of measuring mechanisms and actions (see **Methodological Framework**). As such, my approach to the theory of science can be referred to as *scientific realism* (Bunge, 2006, pp. 29-30; Little, 2015).

Action: A definition

In this section, I define the concept of *action*, since action serves as the main dependent variable in all four studies. As noted above, teachers' and students' actions have consequences that make them important to study (Hedström, 2005). Behavioral disengagement and truancy result in bad grades and school dropouts (Archambault, Janosz, Fallu, & Pagani, 2009). Bad grades and school dropouts may in turn impact students' future labor market outcomes (Le, Miller, Heath, & Martin, 2005; Ryan, 2001). Teaching practices and instructional materials impact students' learning opportunities and may thus affect their knowledge (Claes, Hooghe, & Reeskens, 2009) and civic engagement (e.g., voting behavior, volunteering in associations) .

In this study, I operationalize actions as readily observed behavior in a situation with a choice (Elster, 2007, p. 163). Readily observable behavior denotes physical behavior (e.g., using textbooks in class or arriving late). Situations of choice refer to when a student or teacher has a choice between a set of behavioral alternatives (e.g., between using computers or textbooks, or between engaging and disengaging). These alternatives are to a large extent already defined by school policies, curricula, syllabi, and ethics manuals for the teaching profession. For example, school policies state that students should conduct themselves appropriately and attend classes. But students can choose whether or not to conform to school policies.

Another example is that the ethics manual for the teaching profession states that teachers should individualize their instruction. However, teachers still have a choice between individual and collective teaching.

Usually, studying actions implies focusing on both intentions and observed behavior. However, in both examples mentioned above, the situation of choice imposes itself on the actor, which means that action does not necessitate that the individual actually intended the behavioral outcome. The operationalization of action as readily observed behavior cuts out the intention part of the common definition of action. However, cutting out the intention part is much more suitable in studies of video recordings, since intentions are exterior to such empirical material. There are also other good arguments for this choice of operationalization. First, individuals' intentions tend to average out (with a high probability) as the number of actions studied approaches a very large number (Hechter, 1988; Manski, 1995; Stinchcombe, 1987, 2005). This is because individual actions make up the random error that, in probability, decreases as the number of actions increases.[8] Second, my studies focus on behaviors that have important intended or unintended consequences. Third, the definition of action as readily observed behavior remains continuous with the core definition of action in sociology (Weber, 1983). Weber defined actions as readily observed behaviors related to other people, a definition that I consider similar to my definition. Fourth, the operationalization distinguishes action (choice behaviors) from "reflexive behaviors" (e.g., sneezing, blinking, knee jerking, snoring or blushing).

My studies focus on actions on different levels. The first level is the joint actions of teachers and students. The second level is the individual actions of the student. In **Studies I** and **II**, I define teaching actions as joint actions, since teaching actions tend to require cooperation between teachers and students (Coleman, 1994, p. 136; Kelly, 2009). The reason is that a teacher cannot teach without the students' involvement. For example, if students skip class, arrive late, play with classroom equipment, etc., then the teacher cannot teach. Therefore, I contend that addressing teaching actions as joint actions makes sense (Kelly, 2008). In my studies, joint action denotes that $\geq 50\%$ of the pupils in a classroom acted in the same manner as instructed by the teacher. The methodological reasons for the criterion will be discussed in the methods section.

I found the following actions to be critical in **Studies I** and **II**:

- **Teaching practice** = reciting, lecturing, group work, etc.
- **Usage of instructional materials**= work with textbooks, computers, whiteboard, paper-based materials (e.g., stencils produced by the teachers themselves)

Students' actions do not tend to necessitate cooperation, as a single student can disrupt a lesson (Coleman, 1994). Thus, I operationalized student actions as individual actions. I found the following actions to be critical in **Studies III** and **IV**:

- **Behavioral disengagement** = late arrivals, interruptions, disrespect for property, playing with school equipment, mockery
- **Truancy** = skipping class, skipping school

[8] This argument appeals to the Weak Law of Large Numbers, or "convergence."

- **Commitment** = doing homework, being attentive in class, etc.

Thus, I have answered the question what an action is in the context of this dissertation. In the next section, I move to the question of the causes of actions.

Mechanisms: A definition

Actions as operationalized above are not explained by intentions but rather by mechanisms, which may include intentions. A mechanism can be defined as the pathway or process $\mathbf{M_{t-1}}$ that generates action $\mathbf{Y_t}$ (Gerring, 2008). $\mathbf{M_{t-1}}$ is measured by one or several process variables or intervening variables (Blossfeld & Rohwer, 1997; Gerring, 2008). Process variables have the advantage of being the one of most the compelling forms of evidence in social science (Lieberson, 1985, p. 60). My operational definition, however, deviates from the critical realist definition of mechanism, because critical realists contend that mechanisms cannot be empirically measured (Ekström, 1992). As I see it, there are multiple ways to measure mechanisms—see, for example, the extensive discussion by Morgan and Winship (2014).

In **Studies I** and **II**, mechanisms are measured using process variables at the school class level to explain teaching actions. One example is how teachers' contact with one another influences their choice of instructional material (**Study II**).

- ***Collegial influence*** = Teachers who share the same subject area have more opportunities to interact with colleagues who share the same professional training than teachers with colleagues who do not. Shared professional training increases the opportunities for interaction, fostering unity in beliefs and preferences about teaching (**Studies I** and **II;** (Bidwell, 2006b, pp. 44-45). As such, collegial influence can come both from shared training and subsequent interactions.[9]

In **Studies III** and **IV**, mechanisms are measured by process variables at the student level to explain student actions.

- ***School curriculum subject*** = Teachers and students have different beliefs and preferences about the different content areas taught in schools (**Study III**). Teachers desire to teach certain content because, through their professional training, they believe that this content is valuable. By contrast, students hold different beliefs about what knowledge may be valuable, and this is often due to interactions with peers and family. For example, students might consider learning about world religions to be less valuable than math (Yair, 2000).

[9] Bidwell (2006b) defined the school subject both as a mechanism and as defining "social types." In this Bidwell followed Simmel (2011, p. 12), who defined social types as generalizations about persons that depend on our knowledge about their main activity (e.g., the Catholic, the bureaucrat, the businessmen, etc.). In this context, the social type becomes a reference group (i.e., a group that connects a person to society). Similarly, we can talk about "types of teachers" given their subject. In this case, the social type becomes a reference group.

- ***Peer encouragement*** = At school, students have more opportunities to interact with peers than with adults (**Study III**). Such interaction makes students prioritize approval from peers over that of teachers (Coleman, 1994).
- ***Teacher–student relation*** = Students' feelings toward teachers (**Study VI**). This includes, for example, thinking that the teacher is "fair," "just," or a "buddy." Teachers who forge a relation with students may help prevent student truancy (Hirschi, 2002). Above all, feelings indicate a tendency toward certain actions that arise from the relation between people (Elster, 2007).
- ***School Commitment*** = A student can commit to school by daily interactions and actions (**Study VI**), for example by doing homework, preparing for tests, and paying attention (Morgan, 2002).

The measurement strategies for identifying mechanisms differ between the studies. In **Study IV**, I used cross-sectional data, which means that the data does not change over time. For this reason, I had to use path analyses and structural equation modelling (SEM) to model mediation (Cox & Wermuth, 2001)—for example, how immigration status impacts truancy via school commitment. The logic of analysis is that mechanisms **M** mediate the effects of background variables **X:s** on the dependent variable **Y:s.**

In **Studies I**, **II**, and **III**, I used data with a time series format. In time series data, or panel data, the logic of analysis changes. Although one can capture mechanisms using path models, a simple estimation technique involves using mean subtraction or difference out the constant time effect of background variables **X:s** ("unobserved heterogeneity" or "confounders"). **X:s** tend either not to change or to change very slowly, such that there is little variation over time (Blossfeld & Rohwer, 1997; Cox & Wermuth, 2001). Thus, I can, for example, subtract the unit-specific mean or subtract the estimates for the second time point from the estimates for the first time point. This is carefully described in the methods sections in all of my four studies. The implication is that the measurement error caused by unobserved **X:s** is differenced out from the regression equation. This is generally referred to as dealing with "unobserved heterogeneity" or "confounders" (i.e., due to social class, ethnicity, religion, disability).

I want to impose a limitation on the preceding definition of mechanisms used in my four studies. The mechanisms I list should be conceived as sub-mechanisms **m** of a more general class of mechanisms **M**. A growing number of scholars has suggested that the term mechanism should be reserved for general mechanisms (Hedström & Ylikoski, 2010). In my studies, however, I tend to refer to something rather specific: classroom instruction (sub-mechanism). Sub-mechanisms may be conceived as smaller process contributing to larger, more general processes (general mechanism), such as opportunity mechanisms.

Previous Research

In this section, I will review previous research. I begin with a general description of research on teachers' and students' actions in the classroom. Then I proceed with the specific research that relates to my studies. In the later part, I make three arguments. First, I argue that sociologists of education tend to avoid studying actions. Second, I argue that sociologists of education tend to neglect the study of mechanisms within schools. Third, I argue that the sociologists who do study mechanisms tend to study them outside the context of schools. Thus, my studies make a significant theoretical and empirical contribution to the sociology of education.

General Trends in Previous Research

Three general approaches in classroom studies may be distinguished. One is centered on differences in students' learning (test scores) using large-scale surveys. The second is focused on studying differences in classroom teaching between societies, using video recordings of classroom lessons. The third describes differences between teachers' and students' identities and strategies using ethnographic methods. I will give a short overview of these three approaches before turning to research that is directly relevant to my own empirical studies.

Research on differences in student learning. Researching differences in student learning has been a main focus of educational research. An ongoing topic of discussion has concerned how family background (social class, race, immigration status, cultural capital) impacts students' learning.

The correlation between student learning and background variables such as parents' social class and ethnicity is well established in Europe. In the United States, relatively more emphasis has been given to issues of race and student learning (Kao & Thompson, 2003). Researchers in the American context focus on the effects of social capital (e.g., neighborhood, parental involvement, peers) and schools (e.g., ability grouping, tracking, school type) in increasing or decreasing students' opportunity for learning given their race (Hallinan, 2001). The American studies have generally favored longitudinal data analysis (e.g., National Education Longitudinal Study). In Europe, relatively more effort has gone into researching the importance of parents' social class for student learning. Most researchers have been concerned with aspirations e.g., attitudes toward school or higher education; (Goldthorpe, 2013; Jonsson & Mood, 2008) and cultural capital e.g., number of books at home, fine arts, opera visits (De Graaf, De Graaf, & Kraaykamp, 2000; Sullivan, 2001). By contrast,

in developing societies, the school (e.g., access to textbooks) has been more important for student learning than parents' social class and ethnicity (Buchmann & Hannum, 2001; Heyneman, Farrell, & Sepulveda-Stuardo, 1981).

One important development in this first research strand is the availability of comparative, large-scale surveys such as PISA, TIMSS[10], PIRLS[11], and CIVED[12], which study differences in student learning. These surveys measure students' test scores in mathematics, scientific reasoning, civics, and reading. The main critical difference between PISA and the other surveys is that TIMSS, PIRLS, and CIVED measure abilities in relation to the national curriculum and syllabus for grades 4 and 8, whereas PISA measures the ability to "participate in society" among students in grade 9.

Alongside test scores, these surveys also provide questionnaires for teachers, principals, and parents, and these questionnaires make it possible to study psychological, economical, and sociological topics. For example, educational psychologists tend to study the importance of classroom climate and motivation for test scores (Ainley, Hidi, & Berndorff, 2002). Educational economists tend to study the effects of class size and grouping on test scores using instrumental variables (Angrist, 2014; Hanushek, Kain, Markman, & Rivkin, 2003). Sociologists of education tend to study the importance of schools' average socioeconomic status and cultural capital on test scores (Perry & McConney, 2010). The methods of choice tend to be multilevel models or structural equation models (Yang Hansen, 2008; Yang Hansen, Rosén, & Gustafsson, 2011). Various studies have demonstrated the importance of cultural capital as measured by the number of books at home, highbrow consumption (e.g., fine arts, opera visits), linguistic ability, and/or level of education (Barone, 2006).

Research on differences in classroom teaching. A second strand of research has focused on teachers' and student's speech, using transcripts from audio or video data (Mehan, 1992). Typically, the focus has been on the distribution and sequencing of the teachers' and students' turns at talk (Macbeth, 2003; McHoul, 1990; Mehan, 1979). In a large-scale study, American researchers found that teachers take more turns talking (Gamoran, Nystrand, Berends, & LePore, 1995; Nystrand, Wu, Gamoran, Zeiser, & Long, 2003). Researchers also found differences across school subjects (Gamoran & Nystrand, 1991). There were also differences depending on ability groupings. For example, groups with high ability tend to have longer durations of interruption-free teacher–student conversation compared to groups with low ability. In addition, teachers tend to engage more often in cognitively challenging instruction when teaching students with a high socioeconomic status compared to students with a low socioeconomic status. This also holds for African American students. The differences in instruction are not related to socioeconomic discrimination. Rather, teachers tend to focus on teaching to the state tests (Diamond, 2007).

[10] Trends In Mathematics and Science Study

[11] Progress in International Reading Literacy Study

[12] Civic Education Study

However, the unintended consequence is that students with a low socioeconomic status tend to score lower on cognitively challenging questions on state tests. This means that the students will still fall behind high socioeconomic students. However, this line of research has suffered from problems identifying causal treatment effects of instruction.

Recently, there have been efforts to study teaching comparatively. The TIMSS video study analyzed a random sample of 231 eighth grade mathematics classrooms from Germany (100), Japan (50) and the United States (100, 50, and 81, respectively: (Stigler & Hiebert, 2009). The main conclusion was that mathematics teaching was culturally relative. The authors argued that each nation followed a specific sequence of mathematical activities. For example, Japanese teachers started with a mathematical problem on the board, and American teachers started by collecting numbers from students. Japanese mathematics teachers also tended to meet after class to discuss lesson planning (a.k.a. "lesson studies"). The authors suggested that American teachers could benefit from learning from the Japanese teachers.

Other studies, however, have challenged the claim about homogenous national teaching cultures and argued that teaching activities differ within nations (Clarke, Keitel, & Shimizu, 2006). Taking a relativist position, these researchers have even argued that linguistic differences make comparative research impossible.

Research on teachers' and students' identities and strategies. A third strand of research falls more within the tradition of cultural studies, and it has mainly focused on students' attitudes toward their identity, school, and teachers (Ball, Reay, & David, 2002; Rollock, Gillborn, Vincent, & Ball, 2011; Shain & Ozga, 2001; Youdell, 2003) as well as teachers' coping strategies (Ball, 2003; Pollard, 1982; Woods & Jeffrey, 2002). The main objective has been to demonstrate how students form identities in opposition to their schools. Researchers have associated such identity formation with social class, gender, and ethnicity. For example, do students "conform" or "rebel" in the classroom? And to what extent does this behavior coincide with their identity?

Actions in the Sociology of Education

Sociology of education tends to be concerned with educational attainment (e.g., test scores, marks, enrollment into higher education, etc.). However, sociology of education can also, as discussed above, study actions within schools. Against this background, Bidwell (2006a) argued that sociologists of education pay insufficient attention to the actions within schools, as research tends to focus on describing interactions rather than explaining actions.

Teaching practice. Following Bidwell, I defined two types of action variables related to teacher actions. The first is teaching practice (e.g., recitation, lecturing, seatwork, group work, etc.). We may get some information about such teacher actions from existing data on Swedish teaching. Most important, in a review,

Carlgren et al. (2006) observed the tendency discussed in the introduction—that is, the shift from class teaching to individual teaching since the 1960s in Sweden (Figure 1).

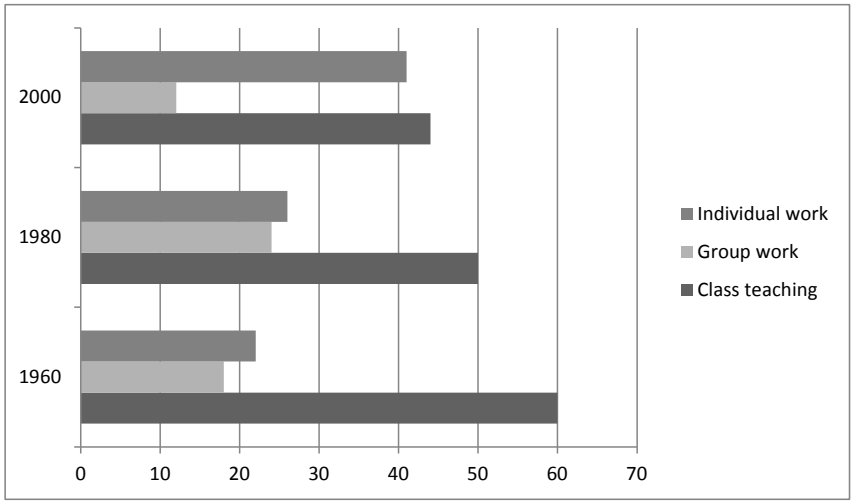


Figure 1. Teaching practice over time. Based on classroom studies.

Source: Adapted from Carlgren et al. (2006, p. 305)

This trend largely overlaps with that of other Nordic societies. The important differences thus seem to be between schools in Nordic societies and schools in other societies. In the United States, for example, lecturing-recitation still dominates teaching practice (Gamoran, Secada, & Marrett, 2006). However, obtaining comparable variables and parameters is difficult. Few attempts have been made to measure teaching practice. American quantitative research in classrooms has focused on measuring teaching as "interaction", (e.g., dialogue or monologue; (Nystrand, 2006) or "instructional strategies" (e.g., modelling, connecting to prior knowledge; (Grossman et al., 2010; Grossman & McDonald, 2008). Similarly, cross-national studies such as TIMSS, PIRLS, and PISA tend to include survey items about instructional strategies for reading and counting (Hansen et al., 2014) but not for teaching practices as such.

In summary, little is known about actual teaching practices in Swedish classrooms today—that is, how they are dispersed across lessons and subject areas, and why.

Usage of material. The second action variable connected to teachers is their choice of instructional materials (e.g., textbooks, computers, paper-based materials, etc.). We actually have data from TIMSS and PIRLS, since these surveys involved a questionnaire asking teachers what kinds of instructional materials they use (Hansen et al., 2014). In the TIMSS grade 8 study, 85% of Swedish math and science teachers reported that they used computers for instruction, as compared to 13% who did not (2% omitted). In addition, 75% of the science teachers reported that a textbook was used as the basis for instruction, whereas 21% reported that

the textbook only was a supplement. Moreover, only 12% used workbooks as the basis for instruction, whereas 72% reported that they used workbooks as a supplement. By contrast, in the TIMSS grade 4 study, 31% of the science teachers used the textbook as the basis for instruction, whereas 56% used it as a supplement. Only 18% used workbooks as the basis for instruction, whereas 68% saw them as a supplement. In general, 90% reported using the computer for instruction. In the PIRLS grade 4 study, 44% of the language teachers reported that a textbook was used as the basis for instruction, whereas 48% reported that the textbook was a supplement. Only 29% reported using workbooks as the basis for instruction, and 62% reported using workbooks as a supplement.

In summary, teachers seem to use all kinds of instructional materials, but little is known in detail about how school subject influences the variation in how teachers organize the work with textbooks and computers or about what they use when they do not use computers and textbooks.

A survey conducted by the National Teacher Union may shed some light on these issues. Teachers were asked about frequency of usage of instructional materials. The response items also clearly included printed materials that they have (re)produced themselves.

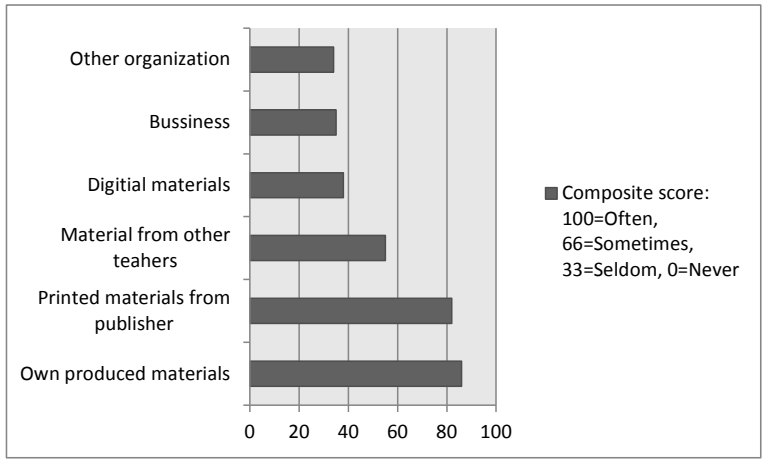
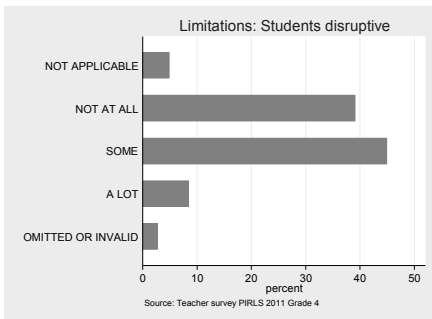


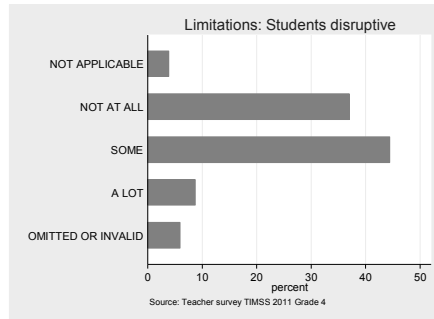
Figure 2. Swedish teachers' reported usage of instructional materials.

Source: National Teacher Union (2014)

As can be seen in Figure 2, the results might indicate a different trend from that discussed above. Teachers use all sorts of instructional materials, but using their own material seems to be preferred. This trend is rather surprising, since textbooks dominate in the United States and in most other societies (Cuban, 1986, 2009). However, these reports do not group the sample into school subjects, so we do not know anything about differences in the use of instructional materials between subject areas.

Student behavioral disengagement. Student actions are also connected to either behavioral engagement (e.g., engaging in homework and paying attention) or disengagement (e.g., skipping class, arriving late, toying with classroom equipment, inattentiveness, daydreaming, interrupting the teacher, etc.). From official statistics, we know that approximately half of the Swedish students in grade 4 report problems of disengagement in the classroom (Statistics Sweden, 2012). Although this data comes from student reports, the pattern can be cross-validated by teacher reports. In the Swedish TIMSS and PIRLS studies, teachers were asked to what extent students' disruptiveness limited instruction. Almost half of the teachers chose the middle alternative, stating that disruptiveness limited instruction to some extent (see the first and second panels of Figure 3).





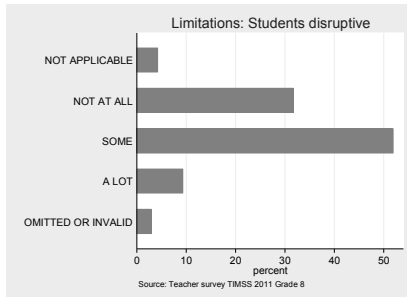


Figure 3. Teacher reports on student disruptiveness. TIMSS and PIRLS.

Source: TIMSS, PIRLS, IEA

A reasonable objection concerns the grade of the students. The reports from Statistics Sweden were conducted with students in grade 4, whereas TIMSS and PIRLS were conducted with teachers instructing

students in grade 4. The third panel in Figure 3 validates the argument that disruptiveness may not be a correlate of age of the student according to teachers, because it also is found in grade 8.

Furthermore, in Figure 4, which is based on the PISA survey of students in grade 9, students reported a comparatively high rate of late arrivals (OECD, 2013). This indicates that behavioral engagement is a great problem in Swedish schools. However, these questions depend on students' recollections, and they consequently suffer from problems with measurement error. Regrettably, to my knowledge there is no Swedish panel data available on students' behavioral disengagement.

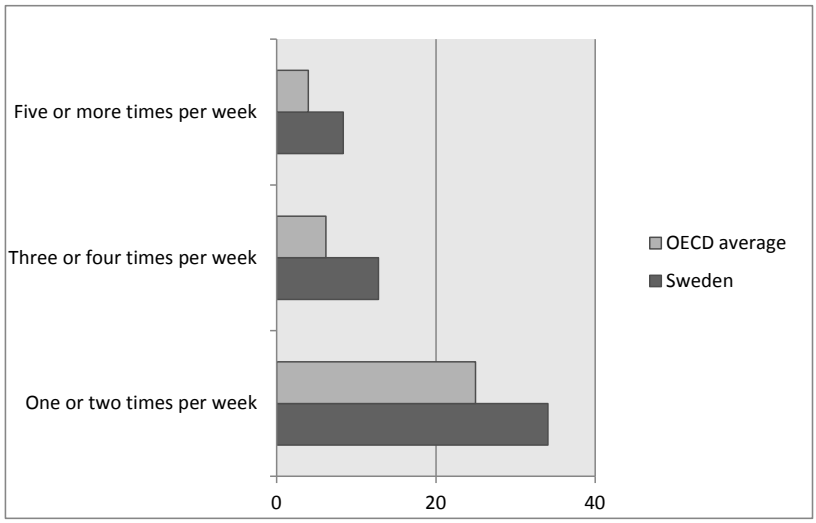


Figure 4. Late arrivals. Student self-reports. PISA. Note: Differences in total percentage are due to the fact that the omitted values are not shown.

Source: PISA, OECD (2013)

Just as previous research on the situation regarding teacher action is inadequate, so it is in the case of student engagement and disengagement. One might turn to qualitative studies from other countries to understand what is going on—for example, research by interactionists such as Willis (1977), Obgu (2004), and Woods (2011), some of whom have been influential in Europe. But as I will discuss below, such studies in the sociology of education seem less helpful for my study, since they tend focus solely on the consequences of background variables. Such a focus on background variables has come at the expense of dealing with actions and mechanisms in classrooms. Thus, sociological knowledge about what is going on inside in classrooms tends to be limited.

However, there are a number of studies from the United States that have been inspired by the sociology of crime (Demanet & Van Houtte, 2011, 2012, 2013; Hirschi, 2002; Van Houtte & Stevens, 2010) and organizations (McFarland, 2001a), and these studies are more helpful for elaborating which mechanisms to study in order to evaluate student actions such as behavioral engagement and disengagement. I will return to the studies in the next section.

Mechanisms in the Sociology of Education

Sociologists of education tend to study the correlation between variables **Y** of educational attainment and background variables **X** (e.g., family background and ethnicity). British (Goldthorpe, 2013), French (Bourdieu & Passeron, 1990), and Nordic (Bæck, 2011) sociologists of education have studied cognitive inequality with respect to social class and ethnicity. Americans sociologists have focused on cognitive inequality with respect to school variables (e.g., tracking, ability grouping, course selection, and subject matter; (Hallinan, 2001). In short, there is a tendency in sociology of education to be concerned with background variables (**X**) to explain educational achievements (**Y**), and not so much with the intermediary mechanism (**M**).

There are, however, two notable exceptions to this tendency to overlook intervening mechanisms in this research. Two types of mechanisms **M** can be found in the studies of social inequality (Nordlander, 2015). First, *cultural capital* explains how access to cultural resources such as books at home, poetry, and opera visits can explain test outcomes among students (Barone, 2006). Second, *risk aversion* (fear of either economic or social status) can explain how marks and ambition can explain enrollment in higher education (Barone & Van de Werfhorst, 2011). For this study, and since our current knowledge about school mechanisms **M** remains insufficient (Bidwell, 2006b), there is a need to elaborate which mechanisms may be of help in explaining the classroom actions that I study. This may be done with help from the mechanism-oriented studies that already exist. The mechanisms that are presented below and that were used in my studies are collegial interactions, time allocation, teacher–student relations, peer encouragement, and school commitment.

Collegial interactions. The research by Bidwell and colleagues (2001) focused on the relationship between mechanisms and actions within schools. Their argument draws on both organizational sociology and sociology of professions. The point of departure is that Swedish schools have a division of labor wherein the principal makes decisions about the allocation of students, the hiring/firing of teachers, the budget, and wages, and the teachers make decisions about teaching practices and instructional materials. Since the principal tends to have difficulties monitoring the teachers' instructional work, teachers have decision-making power over teaching practices and instructional materials. But there also exists a division of instructional labor among teachers. The instructional responsibilities of teachers are organized by student age (grades) and

content area (subject matter). Teachers' daily face-to-face interactions with colleagues tend to be organized around subject areas (Bidwell & Yasumoto, 1999). This is because discussing work-related problems (e.g., lesson planning, methods, syllabus coverage) tends to be more productive if the teachers share a common training and work experience (Diamond, 2007). Consequently, teachers within the same subject area have a stronger sense of professional identity or unity (Ball & Lacey, 2011).[13] In summary, collegial interactions and the common professional training in each subject area are possible mechanisms for explaining teaching practices and the choice of instructional materials (**Studies I** and **II**).

Time allocation. Another potential mechanism is the allocation of time to instruction and teaching materials (Barr & Dreeben, 1977, 1983; Diamond, 2007; Dreeben & Gamoran, 1986; Hallinan & Sørensen, 1983; Hallinan & Sørensen, 1985; Sørensen & Hallinan, 1986). The point is that teachers allocate time to teaching practices and instructional materials depending on the composition of students. The allocation of time to class teaching and individual teaching, or to textbooks and computers, influences students' learning opportunities (e.g., exposure and access to curricular knowledge; (Sørensen, 1983). This may be seen as a mechanism relating to the structural conditions of having to instruct varying class sizes with limited time, which affects teachers' decision-making (Sørensen, 1983). There have been only a handful attempts to model such arguments using observational data (Eder, 1984), but I will try to integrate this mechanism in my analyses (**Study II**).

Teacher–student relations. The relationship between the teacher and the student is a mechanism that may impact student actions (e.g., truancy, disengagement). Teachers have pedagogical authority in relation to students (i.e., authority to direct students to do work). However, teachers do not "possess" pedagogical authority; rather, they earn it by virtue of students' approval. Students' approval of the teacher does not have to do with the legal authority of the teacher, but with the relation between the teacher and the students. If the students feel that the teacher is "fair," "just," "respectful," etc., then the students will approve of the teacher as a "pal" or a "buddy." Such a mechanism has been advanced by sociologists of education (Durkheim, 1925) and criminologists (Hirschi, 2002) to decrease student disengagement (Demanet & Van Houtte, 2012). However, the number of empirical studies that explore the underlying mechanism remain few. Consequently, in **Study VI** I explore potential mechanisms.

Peer encouragement. Another important mechanism to explain student actions is peer encouragement. Students compare themselves to peers as a reference group. Students thereby develop points of reference during their daily interactions with their peers, and these points of reference shape their ambitions (Boudon, 1973). Since students interact more frequently with peers than with adults (Coleman, 1960), they tend to have a stronger sense of loyalty to their peers than to their teachers (Bidwell, 1972; McFarland, 2001a). Even though few attempts at modelling mechanisms of schools using observational data exist (Bidwell, 2006b), one

[13] Such collegial organization was already defined by Weber (1983, p. 188), as when a group collectively gained a monopoly to make decisions within a department (e.g., instruction in subject areas). Weber (1983, p. 194) suggested that collegial organizations gain influence because there is no leader (e.g., principle) or sense of community (e.g., professional training).

fruitful attempt has been to model how institutional mechanisms influence student disengagement (Diehl & McFarland, 2012; McFarland, 2001a). Such analyses typically use event-history analysis and focus on the mechanisms of teacher control and peer influence. The argument has been that too-close friendships and too-strong teacher control leads to student disengagement. In particular, these researchers argue that class teaching pushes middle-class students to disengage, because these students get bored (McFarland, 2001a, 2004). This mechanism is thus an important one in my analyses of student engagement and disengagement (**Study II**).

School expectation and commitment. A final mechanism, which is related to students' ethnicity, immigration background, and social class, is *school commitment* (i.e., doing homework, preparing for tests, paying attention in class, and participating in class). This mechanism may have great influence on truancy. Educational commitment is increasingly used to produce choice models that apply to both ethnicity (Morgan, 2002) and socioeconomic status (Morgan & Kim, 2006)**Study VI**). School commitment may come from students' *expectations* about the consequences of doing homework, preparing for tests, paying attention, etc. If students have more optimistic expectations, then they invest more time and effort on doing their homework, preparing for tests, paying attention, etc.

Such expectations may come from the fact that immigrant parents and their children may be more optimistic than their non-immigrant counterparts in welfare states that are known for providing universal social services for its citizens. For example, immigrants in the Nordic countries expect universal social services such as no tuition fees for higher education, free school meals, student loans, and social security. Among students, this may foster the expectation that one can succeed in school in the host country.

Methods and Data

Table 1 shows the methods and data used in the study and unit of analysis. For the first three studies, I used video data analyzed with multiple methods, such as descriptive statistics, Cox regression, field notes, transcripts, and pictures. For **Study IV**, I used secondary data from OECD analyzed with structural equation modelling. In **Studies I** and **II**, the school class was the unit of analysis. In **Studies III** and **IV,** the individual student was the unit of analysis.

I will structure the remaining method and data section as follows (see Table 1). First, I describe the data collection and participants. Second, I will discuss the methods for analyzing actions and mechanisms: qualitative data analysis, event-history analysis, and SEM. In the last section, I synthesize the arguments into a coherent methodological framework. Finally, some details on event-history analysis and SEM are presented in a separate appendix, discussing estimation techniques and ways of dealing with measurement error.

Table 1. Data and Methods

Study	Data	Method	Unit of analysis
I	Video recorded lessons 74 (78) Coding in Observer XT	Descriptive statistics Cox model Field notes Transcripts Pictures	The school class
II	Video recorded lessons 74 (78) Coding in Observer XT	Cox model Field notes Pictures	The school class
III	Video recorded lessons 74 (78) Coding in Observer XT	Cox model Field notes Transcripts Pictures	The individual student
IV	Secondary data analysis using PISA data	Structural equation modelling	The individual student

Source: Author

Data Collection and Participants

Given the first three research questions and the overall aim, I wanted to collect high-precision data for teachers' and students' actions in the classroom. Cross-sectional survey data generally give reported behaviors, but there are complications with cross-sectional data with regard to time and precision. The first concern in the analysis of the cross-sectional survey data is that the analyst must assume that the probability of an event **Pr(Y)** remains constant over time (Hsiao, 2014). This is an issue of external validity that requires strong theoretical assumptions about the regularity of events. When discussing external validity, we generally

think about generalization of the sample to a population of individuals but not about events over time (Manski, 1995). The former type of generalization may be more important in most cases, but we also have to consider the latter (Manski, 1995). A second concern regards the precision of measurement errors, as surveys can suffer from reporting bias due to imprecise recollection of events (Blossfeld, Golsch, & Rohwer, 2007; Kelly, 2010). Kelly, for example, noted the discrepancy between reported behavior and video data for students. The students tended to underreport behavioral disengagement, whereas teachers tended to over-report behavioral disengagement.

Given these two concerns, I decided to collect video data from classrooms because video data provides the possibility to analyze many data points (events) per lesson, which gives precision and validity to the study of actions in the classroom. As the number of data points increases, so does the precision of the measurement of the event rate.

For the collection of video data from classrooms, I contacted schools in both the inner city and suburbs of western Sweden. In total, 30 school classes were approached, but only four school classes participated in the study in the end. The low response rate[14] was due to difficulties finding teachers who were willing to be recorded. The ambition was initially to create a strategic sample containing both free and public schools, and I had contact with two classes at one free school (see Figure 6). However, the free school dropped out of the study for unclear reasons, and thus, the recordings were omitted.

From the four participating school classes, I recorded 78 lessons during the spring and autumn semesters of 2013. In total, I could use 74 of these recordings.[15] For each session, I used one camera to record the class and one camera to record the teacher, i.e., 78+78= 156 video streams. The camcorders captured the audio.

[14] A response rate of 13%, where the response rate is $\frac{Number\ of\ schoolsparticiapting}{Total\ schools\ contacted} \times 100$.

[15] One recording was dropped in "crafting" due to insufficient comparisons for the subject area. Three recordings were dropped because these were recorded at the free school that dropped out.

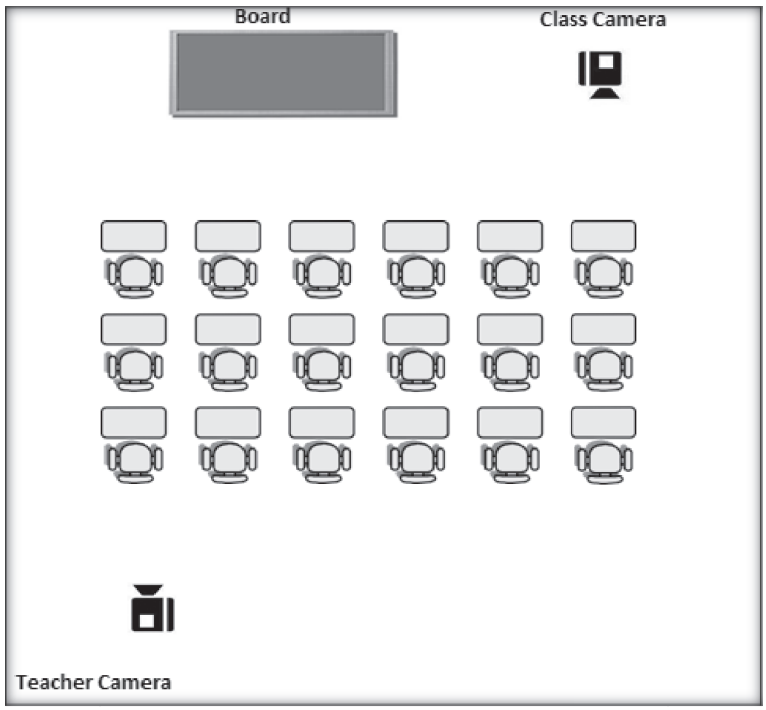


Figure 5. Camcorder set-up.

Source: Author

Reflections. Before moving on, I want to take the opportunity to reflect on the problem of *access*. Getting access to schools and school classes was highly problematic because teachers are not eager to open the doors to their classrooms. As an effect, the response rate and sampling method raise some concerns about self-selection mechanisms. Many of the statistical methods I utilize assume probabilistic sampling at all stages of the data collection. The sample of school classes was strategic and hence non-random. However, sampling of school classes refers to the between unit sampling. The sampling within school class sampling unit (i.e., events) was sampled as a "slow count process" (e.g., similar to the zero inflated Poisson process(Box-Steffensmeier & Jones, 2004). The counts are the number of events (e.g., disengagements) occurring over a specific time interval (i.e., a rate). Such a count process of rates of events can be assumed to be approximately a stratified random sample.

This assumption is similar to that of the time series in which events are assumed to be approximate to a systematic random sample. Thus, for the event-history analysis, I assume that the realization sequences of

events recorded follows a stochastic process, i.e. a Poisson process (Box–Steffensmeier & Zorn, 2002). There, stochastic is synonymous with random.

Research Ethics

As the study contains humans and video recordings, I wanted to test my project for ethical approval and therefore contacted the regional ethics committee before I began the data collection. I informed the ethics committee about my research project and received the response that no application was needed but that I needed to supply information and consent forms to the participants. Consequently, all participants and the parents of the students signed a consent form of agreement before the recordings begun. The consent form included relevant information about the study and its aim.

Participation was voluntary. Two teachers and their school classes dropped out of the study for unknown reasons. Furthermore, a few students did not agree to participate. These students either attended a different class while I was recording, or in one case, an individual student was positioned at a dead angle of the camera during each recording.

In the data analysis, I used fictitious names of the participants and schools. When using snapshots, I used a technique called "line drawings" to ensure the participants' anonymity. Line drawings were an alternative to pixelating the images or manipulating the contrasts.

Procedure for Coding Actions

The coding approach was theory driven rather than data driven (Bakeman, McArthur, & Quera, 1996; Bakeman & Quera, 2011; Derry et al., 2010). I used a program called Observer XT (Zimmerman, Bolhuis, Willemsen, Meyer, & Noldus, 2009). The software allows for (a) synchronizing and (b) coding the video streams (see Figure 7). I coded for events in the classroom. The coding rule was to start coding as the first student entered the classroom and stop when the last student exited the classroom. Each code had a start and a stop state. Accordingly, the program's output consisted of a frequency of stop and start states and the relative time (h; m; s) and duration (sec). The sampling of codes was continuous. My decision to treat time as continuous has pros and cons. I defend my decision on the basis that treating the lesson period time as discrete chunks of time would be arbitrary.

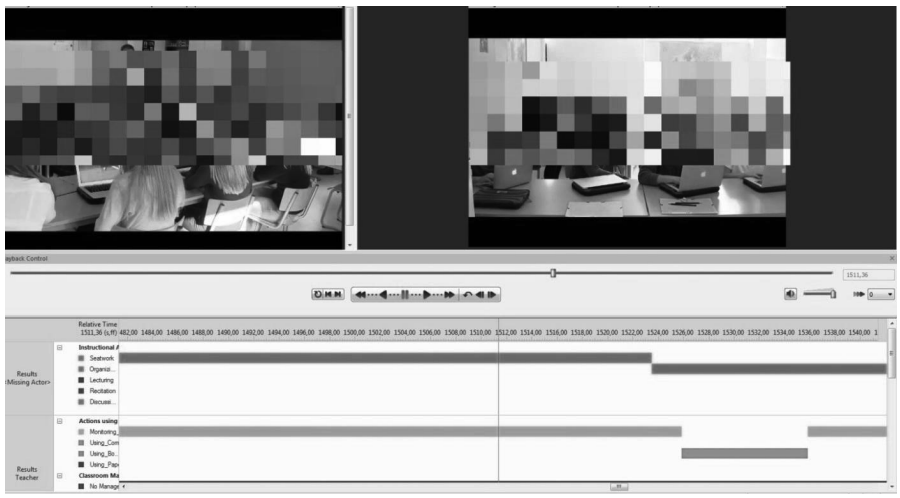


Figure 6. Screenshot of Observer XT

Source: Author

One basic coding principle was that all codes (events) ought to be readily observable behavioral actions (i.e., physical behavior, bodily orientations, gazing, gestures, or facial expressions). The reason I focused on readily observable indictors of action instead of speech was because the former was less arbitrary to code. The following two examples illustrate my point.

Firstly, students tended to switch seats or move around in the classroom, which makes it difficult to trace/assign speech acts to individual actors. Students tended to ignore classroom seating orders, if any existed. Students also interrupt one another and the teacher. Ideally, I would have liked to calculate network measures of speech between students or at least calculate the duration, but neither could be done, as such measures are highly sensitive to measurement error.

Secondly, it is difficult to record desk conversations between students. Getting a good point estimate of the distribution of speech measured by number of turns or duration can be difficult[16]. Desk conversation makes up a great deal of the talking in Swedish classrooms (Emanuelsson & Sahlström, 2008; Lindblad & Sahlström, 1999a; Sahlströma & Lindblad, 1998), but desk conversations are difficult to measure compared to plenary conversations between students and teachers. Problems of measurement include classroom noise and simultaneity of speech, e.g., students interrupting one another or when students converse at the same time.

[16] This problem in observing large groups was established in the criticism of the methods Bales used to code speech (Homans, 1974, p. 37).

Measuring plenary speech alone would give a false impression of classroom talk, as a teacher could dominate plenary conversations, whereas students could dominate desk conversations.

In contrast, readily observable behavioral acts could be coded even in noisy classrooms. However, one problem remained. The coding of teachers' actions differed from that of students' actions. Students' actions could easily be coded on an individual level because a single student can sabotage an entire lesson. However, teaching actions generally required cooperation between teachers and students. Sociologists of education have made this point for quite a while. Therefore, another basic coding principal was established. A teaching practice was coded as a joint action if the action at hand engaged more than or equal to 50% of the participants. Such coding would give a fairly objective indication if the majority of students actually participated in the joint action. The lower bound of the threshold of 50% is arbitrary, as there is no prior research for guiding such a decision, but I found this reasonable. As such, this innovation contributes to advancing the frontiers of research on the topic.

Finally, a third coding principle was established to code only mutually exclusive events. There are both reasons of measurement and practical reasons behind this principle. First, keeping track of parallel behavioral acts is rather difficult, as the number of participants is more than three. Secondly, from a measurement perspective, mutually exclusive outcomes have been agreed to be the least arbitrary when recording events (Pedhazur & Schmelkin, 2013).

Reflections. Before moving on, I want to briefly discuss the problem of developing coding rules and schemes. Theory-driven quantitative coding is a strenuous work. Beyond the work of coding, I revised the coding schemes numerous times after consulting my supervisors and previous research. On the one hand, I wanted to develop a coding scheme that had comparability with previous research. At the same time, the codes from previous research had to be modified to fit my data.

Analyzing Actions and Mechanisms with Qualitative Data Analysis

I will now turn to the qualitative data analysis of transcripts from the video recordings and field notes from the ethnographic work in connection to these recordings (**Study I, II, III**).

Transcriptions. I transcribed a selection of the video data. The purpose of my transcripts were to validate my arguments about the relationship between actions and mechanisms based on quantitative findings (Onwuegbuzie & Johnson, 2006). The transcripts were translated; hence, the wording, spelling, and grammar were adjusted for the convenience of the reader. Furthermore, I included non-word elements (e.g., laughs), gestures (e.g., pointing), and gross physical movements (Hammersley, 2010).

In addition to transcripts, I included sequential pictures in the transcripts to capture, for example, students dancing to mock the teacher (action) and peers encouraging the mocking dance (mechanism) by

laughter, gazes, smiles, and so on. Therefore, I used the pictures to further validate my arguments about the relationship between actions and mechanisms (Onwuegbuzie & Johnson, 2006).

Memos and other forms of data collection. During the recordings, I wrote memos (Corbin & Strauss, 1990, 2008) to reflect upon the school context and teachers. The purpose of these field notes was to be able to give a contextualization of the schools, teachers, and students. I kept notes of what teachers told me about their schools, students and teaching during onsite conversations. For example, some of the schools had specific rules of conduct or pedagogical ideals. These notes were collected through informal conversations[17]. Thus, the notes are sketchy and therefore are given less centrality in the analysis as compared to the coded video recordings and transcripts from these recordings.

In addition, I also wrote field notes in between recordings while walking around the campus or in the staffroom (e.g., how teachers co-planned their lessons or exchanged advice on pedagogical problems). I only used these memos to validate my descriptions and explanations of the quantitative findings (Onwuegbuzie & Johnson, 2006).

Furthermore, I also conducted memo writing concerned with reflections on methods during data collection (Corbin & Strauss, 1990, 2008). These memos were more technical. For example, I found that unmonitored camcorders should always be placed close to the ceiling if possible because students otherwise will tend to trip on or play with them. I also wrote a memo about always bringing an extension cord because electric outlets are scarce in classrooms.

As with any multi-methods study, I had to make trade-offs concerning the time spent on one form of data collection versus other forms; as a consequence, some data will be more dominant than the others in the analysis (Onwuegbuzie & Johnson, 2006). Collecting video data took significant time and effort before, during, and after recordings. Setting up camcorders, packing camcorders, collecting wires, checking memory cards, and so on takes time. By the time I had finished, the teacher had to attend the next lesson or deal with administrative work, and follow-up interviews later on were not possible to perform. Consequently, I put more effort into the video data and gave the other forms of data collection a more secondary analytical importance. My reasoning was that is there is only so much a single researcher can do. Collecting both quantitative and qualitative data at schools takes a lot of time, as noted by previous research (Bidwell & Yasumoto, 1999; McFarland, 2001a). Additionally, an inverse relationship exists between data collection and analysis (Stinchcombe, 2005). The more time one spends collecting data, the less time can be spent on reading and data analysis. I needed time for these other research activities to be able to perform the data analysis on time.

[17] Conversations taking place during the setup of the camcorder and in between recordings.

Analyzing Actions and Mechanisms with Event-History Analysis

From the preceding definitions in the method section, I derived a number of methodological implications about the study of mechanisms of interest to my study. My choice of variables should proximate mechanisms, and I chose to make a quantitative analysis of the video-recorded data in the form of event-history models (**Study I, II, III**).

Event-history analysis is both a set of statistical techniques and a methodological framework. It is a powerful tool for studying actions (Blossfeld et al., 2007, pp. 28-29), and it has been advocated as a good approach for mechanism-based explanations (Blossfeld et al., 2007). In event-history analysis, every action has a *start state* t_0 (i.e., students acting engaged) and a *stop state* t_1 (students acting disengaged). An *event* involves the change between states, i.e., a transition from $t_0 \rightarrow t_1$. The *duration* is the length of the time interval between the start t_0 and the stop t_1. If an event does not occur during an observation (e.g., a lesson) then the event is *censored* (Blossfeld et al., 2007, pp. 38-42).

One might question why I used event-history analysis rather than OLS regression, which might seem like a simpler and more conventional statistical modelling technique. My main reasons not to use OLS regression are related to the Gauss Markov assumptions (GS) of OLS to obtain (a) unbiased point estimates and (b) efficient estimate ("certainty;" (Wooldridge, 2015). First, the data were heavily skewed, so it would be misleading to describe the distribution in the form of OLS regression (Box-Steffensmeier & Jones, 2004). Second, the skewness of the data would cause me to violate the assumption in OLS of normally distributed errors, which is assumed by GS6. Third, the Gaussian Markov assumption for time-series data assumes that both the mean and variance stay constant for most time points (GS 3 and GS 4). This assumption would not hold in my data. Fourth, OLS assumes no serial correlation (GS 5), meaning that the past event does not correlate with the current event. However, as the classroom event at time $\mathbf{t_0}$ correlates with $\mathbf{t_{-1}}$ and $\mathbf{t_{+1}}$, there is serial correlation (first order or higher) in my data.

Fifth, OLS has problems dealing with limited dependent variables (Box-Steffensmeier & Jones, 2004). If I had used OLS on a limited dependent variable, such as a duration variable, the following problems would have occurred. First, the dependent variable duration would have produced estimates with a negative time of teaching practices or student disengagement, for example, which would have seemed as quirky as something out of a science fiction novel. Second, if I had used the binary event as the dependent variable, it would have resulted in other problems related to the excessive number of zeros. Excessive zeros lead to a variance of error that would be non-constant across lessons and events (GS 4). Third, OLS would produce negative probabilities of events (again a quirky result) due to the large numbers of zeros of events not occurring. In general, these problems have to do with censoring, i.e., events that do not occur during data collection.

Event-history analysis (such as the Cox model) solves these problems by first using a censoring indicator $\boldsymbol{\delta}$ (Box-Steffensmeier & Jones, 2004). Censoring indicator $\boldsymbol{\delta}$ can be either one ($\boldsymbol{\delta = 1}$) or zero ($\boldsymbol{\delta = 0}$) to indicate if the event occurred (e.g., disengagement) or did not occur (e.g., no disengagement). Secondly, by

including an exponent in the estimation (see Appendix), the results cannot be negative because exponents are always positive.

Thirdly, the choice of the Cox model has to do with the fact that I had continuous time as opposed to equally spaced intervals (e.g., months, weeks, or quarters). To convert a logistic regression into an event history model, one needs equally spaced time intervals. However, a class period cannot be cut in to smaller chunks of equally spaced time intervals (e.g., 2.5 minutes, 10 minutes) without a high degree of arbitrariness. If one is dealing with continuous time, the Cox model is one of the most flexible models for dealing with all sorts of event-history data.

In retrospect, I should perhaps have played around with parametric models such as the Weibull model. However, as I did not have a clear theory of the distribution of time, it would have been arbitrary to assume a Weibull distribution (Blossfeld et al., 2007).

Another objection to my method choice would be that I could have analyzed the data as count data. Here, I defend my choice, as the Cox model makes better use of the data than an account model would (Box-Steffensmeier & Jones, 2004). The data contains multiple records of observations in school class, lessons, and instances. The unique data structure implies that the instances are collapsed across the lessons. The advantage of my strategy was that I make better use of the data points by not aggregating the events.

Analyzing Actions and Mechanisms with Structural Equation Modelling

In my fourth study, I used SEM for the analysis of the PISA data (**Study IV**). SEM combines path and factor analysis into a coherent framework (Kline, 2011) and allows modelling of statistical mediation and "moderated mediation." Statistical mediation introduces an intervening variable $\boldsymbol{\eta}$. Therefore, dependent variables can act as both dependent and independent variables ("endogenous variables").

Again, one might raise the objection that OLS regressions would have been a simpler analysis to use and interpret. However, OLS regression makes several assumptions about measurement errors that may be implausible in most cases. Typically, analysts use principal component analysis or exploratory factor analysis to identify a set of questions that have a common variance (i.e., correlate with one another). In that case, factor analysis is based on the correlation matrix for calculating the Eigen values and vectors. The analyst goes on to normalize the score of a series of the survey questions that correlate (e.g., by ranking, z-scores and min-max normalization). After normalization, the analyst sums or averages the normalized score into an index. The index is then used in the OLS regression (Nardo et al., 2005). On the basis of conceptual validity, I contend that the strategy I have chosen makes better sense for concepts that can be defined as latent variables composed of indicators. For example, education, income, and prestige compose status, meaning that status is an outcome of indicators. However, the concepts I use should be defined as outcomes of the underlying latent (unobserved) variable. For example, the responses to the questions on behaviors (e.g.,

homework, paying attention) and attitudes (e.g., relation to the teacher) are outcomes of the underlining exchangeable (Brown, 2015).

On the basis of reliability, I contend that summing/averaging survey questions can cause serious measurement bias. By summing/averaging questions, you also add up the measurement error. In my case, I used self-reported attitudes and behaviors (e.g., homework, paying attention, late arrivals, skipping class). Self-reported data of behaviors and attitudes often have more serious problems compared with factual self-reported data, e.g., age, sex, number of siblings, and so on. Many analysts suggest that reliability (measurement error) can be addressed by Cronbach's alpha. Cronbach's alpha is one option, but it can still over- or underestimate measurement error because it does not take into account the individual error of the survey question (Brown, 2015).

Analyzing Actions and Mechanisms: The Synthesis of Method Strategies

In this section, I want to clarify the contributions of the methods chosen drawing on the methodological framework for social causation (Stinchcombe, 1987, 2005). In the "previous research" section, I discussed the problem of measuring actions in the classroom such as behavioral disengagement. In the methods section, I provide strategies for addressing the problem in two different ways: event-history analysis and SEM.

The first argument is that my choice of methods increased the reliability of measure given my interest in modelling mechanisms and actions (Stinchcombe, 2005, p. 115). To identify processes, I wanted to have data on the variation of actions given theoretically relevant variables. Therefore, by collecting video data, I was able to improve the measurement of the social mechanisms and actions because video data increases the precision (Stinchcombe, 2005, p. 110) and exactness (Stinchcombe, 2005, pp. 266-269) of the measurement. Event-history modelling with time varying covariates captures this precision of actions and mechanisms.

Hypothetically, these event processes can be estimated using "count models," such as the negative binominal regression. However, count models aggregate data and, hence, throw away information. Such a course of actions underutilizes the data and yields less precise estimates. Thus event-history models yield more precise measurements and are preferred when possible.

SEM decreases the measurement error in reported data on actions. Such modelling ultimately increases reliability. In addition, I improved the reliability of the measures by visiting the school classes over two semesters. I spent time in the classroom, school hall, cafeteria, and teachers' staff room. The time I spent in the field allowed me to calibrate the measures (Stinchcombe, 2005, pp. 8-9) according to the school context.

A second argument is that my choice of methods increases the validity of the measurement. Video data measure action in real time instead of measuring reported data with a survey, whereas applying SEM increased the *construct validity* of the social mechanisms because the method models the "underlying" (or latent) mechanisms (Stinchcombe, 2005, p. 115).

However, despite my precautions, issues still exist with regard to the measurements used in the study. One measurement issue in my first three studies is that I use proxy variables. Formally proxy variables are a substitute for true variables to avoid omitted variable bias (e.g., education as a proxy for ability). Proxy variables reduce the problem of correlation between dependent variables and measurement error (Wooldridge, 2015). However, proxy variables contain explained, random-error, and systematic-error variance (Pedhazur & Schmelkin, 2013). Systematic-error variance may cause systematic underestimation of the true effect (Wooldridge, 2015). The reason is that the variable only captures part of the explained variance compared to the true variable.

The Studies

Study I

Reichenberg, O. (2016). Identifying Mechanisms of Teaching Practices: A Study in Swedish Comprehensive Schooling. *Scandinavian Journal of Educational Research,* 1-16. Advance online publication. doi:10.1080/00313831.2016.1212262

The first (Reichenberg, 2016) study deals with the following research question: why does the teaching practice of individual work and class teaching occur in Swedish classrooms? The study demonstrates that teachers in my study spend more time on individual teaching (seatwork) than any other teaching practice, which is in line with the tendency toward the individualization of teaching shown in previous research. Moreover, the results show that individual (seatwork) and collective (recitation) teaching practices also co-varied with the subject area: recitation was predicted by social studies, and seatwork was predicted by language subjects.[18] These results can be interpreted as showing that language subjects are the most student-centered, whereas social studies are the most teacher centered, with mathematics/science in between these two subject areas. Using my field notes, I interpreted the results as showing that teaching practices may be explained with reference to teachers' pedagogical ideals, which are influenced by their professional training and identity as subject teachers. Language teachers were the most progressive, whereas social science teachers were the most traditional. Such ideals are supposedly spread through teachers' collegial interactions.

In addition, 24% of the time spent in class was shown to go into other activities than teaching practice. This pattern was the most visible in social studies. The result was surprising because such large numbers have never previously been reported. Supposedly, the result has in part to do with student disengagement in the classroom. Consequently, student disengagement was the topic of the next research article.

Study II

Reichenberg, O. (2015). Explaining variation in usage of instructional material in teaching practice: Collegial focus and teachers' decision-making power. *IARTEM e-Journal, 7* (2), 22-47.

[18] However, the effects were barley statistically significant. The uncertainty had to do with large stand errors. As such, the results were supposedly impacted by the small sample size.

The second study (Reichenberg, 2015) deals with the following research question: why does usage of instructional materials (whiteboards, laptops, paper-based materials, textbooks) vary across Swedish classrooms? In this study, I demonstrated how Swedish teachers and students use paper-based materials more than computers or textbooks in teaching. The teacher's usage of instructional materials was predicted by the subject area. The students' usage was predicted by the class size. I interpreted these results as showing that teachers' usage of instructional materials was influenced by collegial interactions and teaching practice. Teaching practice co-varied with subject area, as did the usage of instructional materials. This argument was illustrated and discussed in detail through a qualitative analysis of snapshots and field notes of how the teachers used instructional materials in respective subjects. Teachers in language subject areas wanted to work in a more flexible and student-centered way; therefore, they preferred paper-based materials. Teachers in social studies desired to be in control over the content and pacing of instruction and hence preferred textbooks. Furthermore, the effect of class size was interpreted as teachers having to allocate time given the size of the group. Due to the increasing number of students, teachers felt the need to accommodate the needs of the students.

Study III

Reichenberg, O. (Resubmitted with minor revisions). Student behavioral disengagement, peer encouragement and the school curriculum: A mechanism approach.

The third study deals with the following research question: why does student behavioral disengagement occur and reoccur in Swedish classrooms? The study demonstrates that peer encouragement predicts student behavioral disengagement (e.g., late arrivals, mockery of the teacher, disruptions). The subject area was also found to be an important predictor for behavioral disengagement. Time (i.e., semester) also had a statistically significant effect. The teacher's sex also mattered, but the effect was not significant across models. Furthermore, the qualitative analysis gave detailed illustrations of how students encouraged their peers to disengage in the classroom. I also showed in the qualitative analysis that it is not only male students but also female students behaviorally disengaged in the classroom. Finally, I showed how subject area content could trigger behavioral disengagement if a student does not approve the value of the content taught – for example, how students in one lesson did not approve of the value of learning about world religions by booing and interrupting the teacher.

Study IV

Reichenberg, O. (Submitted). Mechanisms of student behavioral engagement and mathematics achievement in Sweden.

The fourth study deals with the following research question: why and how do students' school expectations, teacher–student relations, school commitment, and truancy mediate the effect of students' social backgrounds on mathematics achievement across Swedish schools? This article was an attempt to make generalizations about the issue studied in Study III. I departed from similar problems but used another data set that made it possible to make empirical generalizations. Study IV takes on the Program of International Student Assessment (PISA) 2012 for the purpose of secondary analysis. I used SEM to test the mediating effects of four latent variables: school expectations, teacher–student relations, truancy, and school commitment. These latent variables are derived from oppositional culture theories and sociologically inspired rational action theories. I studied how four mediating variables mediate the effect of students' social backgrounds (immigrant and socioeconomic status) on mathematics achievement. All four mediating variables mediate the effects of students' backgrounds with the exception of teacher–student relations. Teacher–student relations had an independent indirect effect on mathematics achievement. I also found a positive relation between immigration status and school expectations and school commitment.

Conclusions: Synthesizing the results

In this section, I want to synthesize the results of the four studies. I begin by summarizing the main contribution of my studies to the sociology of education in Table 3.

In this section, I want to synthesize the results of the studies. I start with **Studies I** and **II**, as these studies correspond to changes in teaching actions. Then, I continue with **Studies III** and **IV**, as these studies correspond to changes in students' actions.

Study I empirically supports previous research by describing the increasing individualization of teaching practices (Carlgren et al., 2006; Lindblad & Sahlström, 1999a). Furthermore, **Study I** supports previous research by demonstrating that subject area predicts teaching practice (Bidwell & Yasumoto, 1999). However, **Study I** does not support American research that reports that social studies teachers are progressive (Bidwell, Frank, & Quiroz, 1997). In contrast, my findings show that social studies teachers are more prone to being teacher centered. Finally, I found that a fourth of the class time goes to non-teaching practices.

Table 2. Synthesis of contributions of the studies to the study of actions and mechanisms in the sociology of education

Research Problem	Study		Contributions to the Sociology of Education
Teacher practice	I	A	A statistical and detailed ethnographic description of teachers' teaching practices across lessons.
		B	Identifying an effect of the school subject on teaching practices in the classroom.
Teacher usage of instructional materials	III	A	A statistical and detailed ethnographic description of variation in usage of instructional materials across lessons.
		B	Identifying an effect of the school subject on the usage of different instructional materials across lessons.
		C	Identifying an effect of the class size on the usage of different instructional materials across lessons.
Student behavioral disengagement	II	A	A detailed ethnographic description of students' behavioral disengagement in the classroom
		B	Identifying an effect of peer encouragement on student behavioral disengagement in the classroom.
		C	Identifying an effect of the school subject on students' behavioral disengagement in the classroom.
Student commitment and truancy	IV	A	Identifying the relation between students' social backgrounds to school's expectations concerning truancy and math achievement.
		B	Identifying the relation between students' social background to school expectations to commitment to math achievement.
		C	Identifying the relation between students' immigration status to school expectations to truancy to commitment to math achievement.
		D	Identifying the path from teacher–student relations to truancy/commitment to math achievement

Source: Author

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My explanations of these findings are that the subject area effects on teaching practices are due to collegial interactions and a common professional training for teachers in a common subject area. However, there are other possible interpretations. Other competing explanations may be teachers' unwillingness to teach in a specific manner. This can be due to variation in the professional training that the teacher has acquired during his or her teacher education (Ball, 1982; Ball & Lacey, 1980). Alternatively, the content of the school subject itself can necessitate teachers to teach in a specific manner (Stodolsky & Grossman, 1995). Yet another alternative may be "random error" during the school day (e.g., the weather), as teachers themselves like to note. Furthermore, due to the sample size, response rate, and meager statistical effects, these results should be interpreted with great caution. Although I do identify a school class's specific effects, this effect cannot be generalized to a wider population.

Study II contributes to previous research by supporting reports that teachers use text-based materials more than textbooks or laptops. The study also suggests that class size affects students' usage of instructional materials in teaching practice, as do school subjects: language subject teachers are more prone to use paper-based materials (e.g., stencils) than social studies teachers. Social studies teachers are more prone to use textbooks.

My interpretation of these findings is that the subject area effects on the usage of instructional materials are due to collegial interactions and a common professional training during teacher education (Bidwell & Yasumoto, 1999; Spillane, Parise, & Sherer, 2011; Zhao, Lei, & Frank, 2006). Moreover, I explain the class size effects on students' usage of instructional materials in teaching practice as being due to time-allocation mechanisms (Hallinan, 2004; Sørensen, 1983, 1987).

However, there are other possible explanations. For example, specific aspects about the subject content may fit better with a specific type of instructional materials (i.e., a theoretical curriculum explanation). The effect of class size can also be interpreted as a "frame factor" as suggested by the "frame factor theory" (Lindblad & Sahlström, 1999b). Frame factor theory has a long standing in Swedish research but is more or less unknown to non-Swedish researchers. Furthermore, due to the sample size and response rate implications, these results should be interpreted with great caution. Although I identify a school class–specific effect, this effect cannot be generalized to a wider population. Regrettably, I was not aware of the TIMSS survey questions on teaching materials. This was a valid criticism I received from the reviewers of the paper. The TIMSS questions could have been used to rule out competing explanations.

Study III contributes to previous research by suggesting that peer encouragement and school subject can predict student behavioral disengagement. Previous research (Fredricks, Blumenfeld, & Paris, 2004) has

primarily addressed cognitive and emotional types of disengagement but less so with behavioral disengagement. One reason for this is that behavioral disengagement tends to be difficult to measure. Therefore, the study contributes to previous research. Thus, a more precise measurement is achieved. In addition, the study gives detailed ethnographic description of the process of generating student behavioral disengagement.

My interpretation of the findings is that peer encouragement and school subject can predict students' behavioral disengagement due to the mechanisms of peer encouragement and school curriculum subject (Bernstein, 2004; Coleman, 1994). However, I cannot rule out competing explanations. One alternative explanation is that the students rebel because they find some teaching to be too rigid and boring (e.g., teacher-centered teaching; (Diehl & McFarland, 2012; McFarland, 2001b). Regrettably, I was not able to set up my data in such a way that I could test this theory. Another possible explanation is that peer encouragement is due to cliques in the students' social networks (Diehl & McFarland, 2012; McFarland, 2001b). Initially, I wanted to test the network theory but gave up that idea due to technical difficulties. I was not able to administrate a survey with sociometric measurements. Furthermore, due to the small sample size and response rate, these results should be interpreted with great caution. Although I do identify a student-specific effect, this effect cannot be generalized to a wider population.

Study IV provides a context-specific test of mediating variables of prediction related to oppositional culture theories and sociologically inspired rational action theories**.** In addition, **Study IV** adds to my other studies by suggesting negative consequences of behavioral disengagement (truancy and lack of commitment) on average mathematical achievements. In particular, I contribute by demonstrating how the relationship between student background and math achievement is mediated by (1) school expectations of truancy, (2) school expectations of commitment, and (3) expectations to truancy to commitment. I also identify (4) an independent indirect effect of the teacher–student relationship on the average predicted mathematics achievement.

However, I do want to raise the caution that the analysis is based on cross-sectional data rather than longitudinal data. Longitudinal data could solve the problems of detecting causal effects in the study but is not available for the Swedish PISA. I cannot rule out reverse causality (e.g., good math students do not skip class). Finally, the study was based on the Swedish sample, and one should be cautious in generalizing to other countries, as the welfare contexts differ.

Societal Significance

In this section, I want to briefly address the societal significance of the study. My contribution to the sociology of education has been four studies on mechanisms and actions. The study of teaching and student actions has importance due to their societal consequences.

How teachers teach has great implications for how schools fostering students into future citizens. Teachers involve students more in individualized teaching practices and less in collective forms of teaching. Teachers also spend less time with the textbook compared to paper–based materials. Such individualized teaching aims to foster more individual citizenship and personal development. On the one hand, the emphasis on citizenship based on personal development has a great continuity with the current Swedish curriculum, which stresses personal development. This is also in continuity with public opinion, as Swedes tend to highly value self-development compared to other nations. On the other hand, a reasonable speculation is that individualized teaching implies that schools de-emphasize fostering attitudes of civic duties toward a collective (e.g., the welfare state). Extending this speculation, this may contribute to the general trend of individualization in other parts of society such as economy, politics, and religion.

Future research could shed light on these speculations by studying changes in students' attitudes of duties towards collectives in Nordic societies (e.g., using data from the IEA[19] Civic Education Study). Another possibility would be to test for cohort effects in attitudes towards the welfare state. Yet another possibility would be to study if increasing individualization of teaching causes increases in teacher and student dropout rates. Sociologists of education have been advocating for a long time that a lack of collectiveness in higher education causes student dropout. Such an argument can be extended to the earlier stages of education. One can also discuss if this has implications for teachers' dropout rates.

The extent to which teachers use textbooks and computers has consequences for content coverage. The more time teachers allocate to using textbooks and computers, the more content the students can cover. The more content that can be covered, the more learning opportunities students have. More exposure does not necessarily imply that students learn more; nevertheless, students have a greater chance of learning as the rate of exposure increases.

The fact that teachers still use textbooks implies that teachers make active choices concerning instructional materials. This is what was intended by the deregulation of textbook control in Sweden. However, although the intention was that education should be computerized, this has not been realized to any greater extent. The potential consequence is that a lot of money goes to computerizing education that perhaps could have been more efficiently spent.

How students act have consequences for their test scores and grades (e.g., **Study IV**). Students' test scores and grades have consequences for success in the labor market. Therefore, the study has consequences for how schools contribute to stratification in society. Future research could clarify the effect of student behavioral disengagement on success in the labor market. Another topic for future research is to investigate if student behavioral disengagement has the same consequences for all social groups. Behavioral disengagement is not unique to disadvantaged social groups; it happens even at boarding schools for the social elite. Thus, the question arises as to whether some social groups have more "second chances" in school.

[19] International Educational Assessment

Practical Significance

In this section, I want to bring the reader's attention to the practical significance of the studies for educational policy (see Table 3), as sociological knowledge can offer guidance suggestions for educational policy (Coleman, 1994, p. 624). Such guidance may be useful to decision-makers, such as school leaders, teacher educators, or school politicians.

My policy contribution addresses the two main changes discussed in the introduction, namely, changes in teachers' and students' actions. I begin by posing a suggestion and then discuss potential consequences.

Table 3. Policy implications based on the studies.

Study	Policy Issue	Suggestions for Policy
I & II	Teaching practices and materials	Design subject-specific training programs and professional development
III & IV	Student behavioral disengagement	Continue to set homework in schools Continue to provide courses in teacher–student relationships

Source: Author

One policy issue is how to change teachers' teaching, practices, and usage of instructional materials. My suggestion would be to design training programs that target teachers by school subject (**Study I, II**). Such considerations could also be applied to teacher preparation and education. Teachers tend to discuss pedagogical issues concerning practice and instructional materials with teachers who teach the same subjects. Therefore, teacher education and training programs may benefit from being subject specific.

Another policy issue concerns how to deal with students' behavioral disengagement and truancy. One suggestion is to focus on policies that foster teacher–student relationships (Study IV). At the moment, the teacher education program provides courses aimed at teacher–student relationships. However, teachers can still face difficulties in fostering teacher–student relationships because teachers have to earn respect from students. As such, fostering teacher–student relationships requires hard work.

Another suggestion is to set homework for students at school (Study IV). On the one hand, students may receive unequal help with homework from parents because homework can be difficult for some parents depending on their level of education. On the other hand, homework may increase student's behavioral engagement in school. At home, students do not have to worry about what peers may think of them for doing school work, whereas in school, students worry about gaining respect from their peers. Doing schoolwork may "not be cool" (Study III). Accordingly, the consequences of behavioral disengagement for student test scores has to be weighed against the consequences of students receiving different degrees of help at home.

Swedish Summary

I denna avhandling studerar jag de mekanismer som kan ligga bakom lärares och elevers handlingar. Med begreppet handling avses i denna avhandling; (1) undervisningspraktiker i klassrummet, (2) lärares och elevers arbete med läromedel i klassrummet, (3) elevers stök i klassrummet, (4) elevers skolk, elevers läxläsning, elevers uppmärksamhet i klassrummet. Med begreppet mekanismer avses i min avhandling de processer som leder till lärares och elevers handlingar. Exempel på mekanismer är kollegial interaktion mellan lärare, lärares tidfördelning, kamratuppmuntran, emotionella band mellan lärare och elev. Mekanismförklaringar hjälper oss att få svar på varför-frågor. Mitt val av mekanismer – som begrepp- motiveras utifrån att studier inom utbildningsvetenskap tenderar att vara beskrivande snarare än förklarande. Mitt val av handlingar – som begrepp- motiveras utifrån att studier av skolor tenderar att fokusera på tal som beroende variabel (dvs. utfallet). Mer sällan studeras handlingar som beroende variabel. Genomgående använder jag mekanismer som förklaringsvariabel och handlingar som beroende variabel.

I avhandlingen uppmärksammar jag att mekanismer och handlingar i skolor har studerats i liten utsträckning. Tidigare forskning har framför allt studerat elevers skolresultat samt hur skolresultat påverkas av elevers sociala bakgrund. Däremot finns det färre studier om vilka processer (mekanismer) i skolan som bidrar till att förklara sambandet mellan elevers bakgrund och lärares och elevers handlande. Därför finns ett behov av att studera mekanismer och handlingar för att bidra till förklaringar om vad för sociala processer som ligger bakom lärares och elevers handlingar i skolan.

Avhandlingen är uppdelad i fyra delstudier. De tre första delstudierna bygger på videoinspelningar från över 70 lektioner. Dessa videoinspelningar har jag analyserat dels kvantitativt (händelseförloppsanalys) dels kvalitativt (analyser av bildsekvenser och transkriptioner). Den fjärde delstudien däremot har bestått av analyser av sekundärdata från PISA 2015. Analyserna genomfördes med hjälp av strukturell ekvationsmodellering.

Studie 1

Den första studien syftar till att studera variation i undervisningspraktiker. Här vill jag försöka att förklara varför bänkarbete (eget arbete) dominerar över katederundervisning. Tidigare forskning pekar på hur svensk skola gått från att domineras av katederundervisning till att domineras av bänkarbete. Mina resultat ger endast svagt stöd för detta påstående. Vidare fann jag att skolämnet är en relevant förklaringsvariabel för bänkarbete och katederundervisning. Däremot hade klasstorleken liksom terminen (höst/vår) ingen inverkan på valet av undervisningspraktik. Den statistiska analysen utmärks emellertid av en hög grad av osäkerhet och därför bör resultaten tolkas med yttersta försiktighet. Min förklaring till resultaten är att lärares kollegiala samarbete inom

ämnet har betydelse för lärares val av undervisningspraktik. Anledningen är att lärare lägger mer vikt vid samtal med andra lärare med liknande ämnesinriktning och arbetslivserfarenheter.

Studie 2

Den andra studien syftar till att förklara variationen i läromedelsanvändning. Tidigare studier diskuterar hur läroboken dominerat svensk undervisning. Lärobokens dominans är något som även utmärkt amerikanska, europeiska, asiatiska och afrikanska skolor. Lärobokens dominans kan tyckas förvånande eftersom såväl svenska som amerikanska utbildningspolitiker investerar stora summor på att undervisningen skall bli datorbaserad. Sverige utmärker sig bland andra länder vad gäller stora satsningar på digitala läromedel men en blygsam användning av dem. Mina resultat tyder på att läroboken inte längre dominerar. Men Sverige utmärkers sig då datorn och andra läromedel ännu används liten utsträckning trots att tillgången på digitala läromedel är god. Istället tycks lärare i hög utsträckning göra sina egna läromedel, dvs. läromedelen är pappersbaserade (t ex. stenciler, utskrifter etc.) Lärarens val av läromedel varierar dock mellan skolämnena. Min förklaring är återigen att lärares kollegiala samarbete (t ex. lektionsplanering, didaktiska diskussioner) inom ämnet var betydande för lärares val av läromedel. Vidare hade klasstorleken betydelse för lärarens val av läromedel. Min förklaring är att klasstorleken påverkar tidsfördelningen av lektionen. I takt med att antalet elever varierar måste lärare variera valet av läromedel för att tillgodose variationen i elevernas individuella behov i klassrummet.

Studie 3

Den tredje studien syftar till att förklara variationen i elevers bristande engagemang på lektionen, dvs. stök. Brist på engagemang definieras som sena ankomster, lek med klassrumsmaterial, förlöjligande imitationer av läraren, avbrott och bristande uppmärksamhet. Mot bakgrund av tidigare studier tar jag min utgångspunkt i kamratgruppspåverkan och skolämnespåverkan. Min studie visar att kamratgruppen har en stor betydelse för elevers agerande i klassrummet. Min förklaring är att elever söker uppmuntran från kamrater eftersom kamrater betyder mer för eleverna än läraren under skoltiden. Vidare tycks elevers engagemang i klassrummet variera beroende på skolämnet. Min förklaring är att elever tenderar att ge mindre uppskattning åt somliga ämnen.

Studie 4

Den fjärde studien syftar till att förklara variationen i skolk samt vilka konsekvenser elevers förväntningar, lärar-/elevrelationen, skolk och engagemang får för elevers resultat i matematik. Matematik valdes eftersom jag ville minska risken för mätfel dels beroende på elevernas språkliga förmåga dels beroende på elevernas olika grad av läsförståelse av svenska matematiktexter. Risken för mätfel hade sannolikt varit

större om jag valt testet i läsförståelse. I studien presenterar jag tre förklaringsmodeller. Hypoteser från samtliga modeller prövas med hjälp av sekundäranalyser av PISA 2012. För det första visar jag hur relationen mellan elevens sociala bakgrund (socioekonomisk och utländsk bakgrund) och matematikpoäng medieras av förväntningar och skolk. För det andra visar jag på hur relationen mellan elevens sociala bakgrund och matematikpoäng medieras av förväntningar och engagemang. För det tredje visar jag på hur relationen mellan elevens sociala bakgrund och matematikpoäng medieras av förväntningar, skolk och engagemang. För det fjärde visar jag hur lärarens relation till eleverna indirekt påverkar elevens genomsnittliga matematikpoäng, oberoende av elevens sociala bakgrund. I studien argumenterar jag för att resultaten måste förstås mot bakgrund av den nordiska välfärdsmodellen. Den nordiska välfärdsmodellen kan vara viktig för att fostra förväntningar om möjligheten att lyckas i skolan om man får rätt studieförutsättningar, dvs. kommer igång med läxläsning, är uppmärksam på lektionen och får en bra relation till läraren.

Slutsatser och policyimplikationer

En slutsats är att skolämnet har betydelse för lärares handlande. Implikationen blir att när skolpolitiker och rektorer beslutar om att införa av nya undervisningsmetoder och läromedel kommer de nya arbetssätten sannolikt att tas emot olika beroende på lärarnas undervisningsämne. Därför måste man räkna med att lärares ämnesmässiga förutsättningar att införa nya arbetssätt skiljer sig åt.

En annan slutsats är att kamratgruppen liksom ämnesinnehållet har betydelse för elevers benägenhet till stök. Implikationen är skolpolitiker och rektorer - när de utformar åtgärder mot stök - bör beakta att en stökig elev sällan agerar ensam utan under inflytande av andra är man utformrar åtgärder mot stök. Ytterligare en slutsats är att flera sociala mekanismer – såsom (a) skolförväntningar, (b) skolengagemang och (c) lärarelevrelationen- kan motverka skolk och stök. Skolk bör tas på allvar då konsekvenserna för matematikresultaten är tydliga och kan bidra till ökad ojämlikhet med avseende på elever med låg socioekonomisk bakgrund respektive utländsk bakgrund.

Appendix

I have created an appendix to give the reader a more general clarification of my methods. Here, I placed technical aspects that provide insight on the statistical techniques as such.

Cox regression and Event-history analysis

The Cox Proportional Hazard Model. This model is formal.[20] If we first think of the probability of an event not occurring, $\boldsymbol{t \leq T}$, i.e., a survival function **S(t)**. $\boldsymbol{S(t) = [\, T \geq t]}$, **m**eaning that the probability of an event is **1-**$\boldsymbol{[\, T \geq t] = t \leq T}$**.** Second, if we think of the hazard function as $\boldsymbol{h(t)}$, the hazard function is about the instant hazard rate (or "risk").

$$\boldsymbol{h(t) = lim_{\Delta t \to 0} \frac{Pr(t \leq T < t + \Delta t \,|T \geq t)}{\Delta t}, \; (1)}$$

The hazard function $\boldsymbol{h(t)}$ is a function to a limit $\boldsymbol{(\lim_{\Delta t \to 0})}$ as time **t** gets closer and closer to zero. **Pr** is the conditional probability of the event occurring within a continuous interval $\boldsymbol{t \leq T < t + \Delta t}$. The probability of the event occurring within an interval is conditional upon that the event has not occurred $\boldsymbol{T > t}$, as the function wants to adjust for the probability of the event occurring, given that the event has not occurred. The numerator is logical if you are interested in the risk of an event that has not yet occurred, but the risk should also decrease the longer the time to the event's occurrence to adjust for the probability of the event occurring given that the event has not occurred, with respect to the denominator Δt. Note that the equation cannot be solved by the common limit solution, i.e., plugging in the limit (in this case: zero) Δt in the numerator. We cannot divide a number by zero because that solution would make the equation undefinable. Instead, we add the proportion of events and durations separately up to the limit and then solve the equation. Now, I will proceed to the Cox model.

$$\boldsymbol{h(t|X) = h_0(t)\, exp(\beta_{1x1} + \cdots \beta_{pxp}), \; (2)}$$

The right side of the equation $\boldsymbol{h(t|X)}$ is the hazard function conditional upon a vector of explanatory variables **X** occurring at time **t**. At the left side of the equation is the expected baseline $h_{k0}(t_i)$. This part is left undefined in the model; hence, there is no constant in the Cox regression models. Moreover, **exp** is the exponent of the coefficient **B** for the explanatory variables **X** to the **p** number of coefficients and variables.

Estimation. The probability of the jth case to experience the event at time $\boldsymbol{T_i}$ is:

$$\boldsymbol{Pr\left(t_j = T_i \middle| R(t_i)\right) = \frac{e^{\beta' x_i}}{\sum_{j \in R(t_i)} e^{\beta' x_j}}}$$

[20] Other names include Cox model, Cox regression, and hazard regression. Proportional hazard has to do with the assumption in non-stratified models.

There, the number of cases at risk at a specific time is $\boldsymbol{R(t_i)}$. To estimate the model, I use the partial likelihood function. This likelihood function implies take the product for all observation starting from **i**=1 to the **k**th observation. However, note that the Cox model only uses the information from the events that occur, i.e., $\boldsymbol{\delta_i = 1}$. This means that $\boldsymbol{\delta_i}$ is the event indicator when $\boldsymbol{\delta_i = 1}$ information is added to the estimation but not when $\boldsymbol{\delta_i = 0}$. As can be seen below, if no event occurs ($\boldsymbol{\delta_i = 0}$), the estimate becomes zero.[21]

$$\boldsymbol{\mathcal{L}_p = \prod_{i=1}^{K} \left[\frac{e^{\beta' x_i}}{\sum_{j \in R(t_i)} e^{\beta' x_j}} \right]^{\delta_i}}$$

As with maximum likelihood, using the log is practical. The log also means that we can sum ($\boldsymbol{\Sigma}$) the values. This is one rule of logs[22]. Another rule of logs also allows us to change a fraction with two logs into a subtraction of two logs[23].

$$\boldsymbol{log\ \mathcal{L}_p = \sum_{i=1}^{K} \delta_i \left[\beta' x_i - log \sum_{j \in R(t_i)} e^{\beta' x_j} \right]}$$

Repeated events may involve tied events, e.g., when school classes experience the event at the same time. To deal with this, I used the Efron method. I prefer Efron because it takes into account the sequencing of event. Other methods, like Breslow, ignore information about sequencing because it uses the sum of all observations at risk in the denominator. Let us look at an example of Efron: $\boldsymbol{\psi = exp^{\beta' x}}$ and $\boldsymbol{\ell_1}$ and $\boldsymbol{\ell_2}$ are the likelihood of the first and second case, respectively. For simplicity, we assume four cases. Then, Efron would yield the following:

$$\boldsymbol{\ell_1 = \frac{\psi(1)}{\psi(1) + \psi(2) + \psi(3) + \psi(4)} \times \frac{\psi(2)}{\psi(2) + \psi(3) + \psi(4)}}$$
$$\boldsymbol{\ell_2 = \frac{\psi(2)}{\psi(1) + \psi(2) + \psi(3) + \psi(4)} \times \frac{\psi(1)}{\psi(2) + \psi(3) + \psi(4)}}$$

In the first case, the hazard rate ($\boldsymbol{exp^{\beta' x}}$) for the specific case is divided by all four cases. Then, it is multiplied by the second case divided by all cases except the first. For the second case, I reverse the operation. The general formula looks a bit complicated but it is in principle the same as defined above.

$$\boldsymbol{\mathcal{L}_{Efron} = \prod_{i=1}^{K} \left(\frac{e^{\beta' x}}{\prod_{r=1}^{d_i} \left[\sum_{j \in R(t_i)} e^{\beta' x_j} - (r-1) d_i^{-1} \sum_{j \in D(t_i)} e^{\beta' x_j} \right]} \right)}$$

[21] Note if the substituting in $h_0(t_{1_1})$ as the Cox model was defined above: $\frac{h_0(t_{1_1})\, e^{\beta x1}}{h_0(t_1)e^{\beta x1} + h_0(t_1)e^{\beta x2} + \cdots + h_0(t_1)e^{\beta xk}}$. Then $\boldsymbol{h_0(t_{1_1})}$ chancels out of the numerator and denominator : $\frac{e^{\beta x1}}{e^{\beta x1} + e^{\beta x2} + \cdots + e^{\beta xk}}$.

[22] That is $\log(h(x)) = \log(f(x)) + \log(g(x))$

[23] That is $\log(x1)/\log(x2) = \log(x1) - \log(x2)$

Proportionality. The name proportional hazard comes from the assumption of that the hazard rates ought to be proportional between two cases.

$$\frac{h_i(t)}{h_j(t)} = exp\{\beta_1(X_{I1} - X_{J1}) + \cdots + \beta_K(X_{IK} - X_{JK})\},$$

When you have time-varying covariates, this assumption tends to fall apart, and the Cox model becomes biased. In my studies, this is a problem, as I deal with repeated events as opposed to single events.

What can be done? There are many possible solutions. I chose the solution to estimate a stratified Cox model:

$$h_k(t_i|x_i) = h_{k0}(t_i)\, exp(\beta_x),$$

There, **h** is the hazard, and $h_k(t_i|x_i)$ is the hazard function. The function is estimated for **K** the school class as stratum at the risk time **t** (i.e., duration) for when the explanatory variable **X** occurs. Furthermore, $h_{k0}(t_i)$ is the expected baseline of the hazard function in the strata **K** (school class), and **exp** is the exponent of the coefficient **B** for the explanatory variables. We obtain the instant hazard rates. Such rates are difficult to interpret. A more sensible way is to use hazard ratios. To do so, you reorganize the equation $\frac{h_k(t_i|x_i)}{h_{k0}(t_i)} = \mathbf{exp}(\beta_x)$. There, you take the exponent of the coefficient, and thus, we can interpret the coefficients as the ratio of the hazard when **X** =1 is relative to the baseline and when **X**=0. The interpretation is always comparative (=relative). The ratio of the hazard is like an odds ratios in a logit model (i.e., multiplicative). Therefore, you can interpret the coefficients as a multiplicative (or factor) increase in hazard or risk like an increase in the odds of something happening. If the ratio is close to or less than 1, it no longer makes much sense. What I like to do is calculate *(hazard ratio-1) · 100*. Now, you get a less awkward interpretation: a relative risk percentage. The model specification in **Study I** of teaching practices was as follows:

$$h_{scholclass}(t_i|x_i) = h_{scholclass\,0}(t_i)\, exp\begin{pmatrix} \beta_1 SCHOOLSUBJECT \\ +\beta_2 TIME + \beta_3 CLASSSIZE \\ +\beta_4 TIME \end{pmatrix},$$

Finally, **Study II** was specified as

$$h_{scholclass}(t_i|x_i) = h_{scholclass\,0}(t_i)\, \mathbf{exp}\begin{pmatrix} \beta_1 SCHOOLSUBJECT \\ +\beta_2 CLASSSIZE \end{pmatrix}, (6)$$

The model specification in **Study III** of student disengagement was

$$h_{scholclass}(t_i|x_i) = h_{scholclass\,0}(t_i)\, exp\begin{pmatrix} \beta_1 PEER \\ +\beta_2 SCHOOLSUBJECT \\ +\beta_3 CLASSIZE \\ +\beta_4 TIME + \beta_5 TEACHERSEX \end{pmatrix}, (5)$$

Structural equation modelling

If the unobserved variable is treated as an outcome, the notation tends to shift. This is an example of a measurement model with one unobserved variable $\boldsymbol{\eta}$ and with three observed variables $\boldsymbol{y}$. In this measurement model, the factor loadings $\boldsymbol{\lambda}$ can be interpreted as regression coefficients. This is an unstandardized factor solution; thus, one coefficient is constrained to 1.

$$\boldsymbol{y = \Lambda_y \eta + \varepsilon,} \begin{pmatrix} \boldsymbol{y_1} \\ \boldsymbol{y_2} \\ \boldsymbol{y_3} \end{pmatrix} = \begin{pmatrix} \boldsymbol{1} \\ \boldsymbol{\lambda_{y21}} \\ \boldsymbol{\lambda_{y31}} \end{pmatrix} (\boldsymbol{\eta_1}) + \begin{pmatrix} \boldsymbol{\varepsilon_1} \\ \boldsymbol{\varepsilon_2} \\ \boldsymbol{\varepsilon_3} \\ \boldsymbol{\varepsilon_4} \\ \boldsymbol{\varepsilon_5} \\ \boldsymbol{\varepsilon_6} \end{pmatrix}$$

Survey data uses self-reported behaviors (e.g., homework, paying attention, late arrivals, skipping class). Self-reported behavior can be falsely reported (e.g., problems of recollection of past events). For standardized factor loadings, I used multiple items from the survey to estimate the error $\boldsymbol{\delta}$ for each survey item. For example, three items yield three errors $\boldsymbol{\delta}$ that I derived by subtracting one from the squared factor loading $\boldsymbol{\lambda}$ for the item.

$$\boldsymbol{\varepsilon_1 = 1 - \lambda_{y11}^2}$$

$$\boldsymbol{\varepsilon_2 = 1 - \lambda_{y21}^2}$$

$$\boldsymbol{\varepsilon_3 = 1 - \lambda_{y31}^2}$$

Let us exemplify with a two-factor model ξ_1 with three items. This is a measurement model for two unobserved variables (factor).

$$\boldsymbol{X = \Lambda_x \eta + \delta,} \begin{pmatrix} \boldsymbol{x_1} \\ \boldsymbol{x_2} \\ \boldsymbol{x_3} \\ \boldsymbol{x_4} \\ \boldsymbol{x_5} \\ \boldsymbol{x_6} \end{pmatrix} = \begin{pmatrix} \boldsymbol{1} & \boldsymbol{0} \\ \boldsymbol{\lambda_{x21}} & \boldsymbol{0} \\ \boldsymbol{\lambda_{x31}} & \boldsymbol{0} \\ \boldsymbol{0} & \boldsymbol{1} \\ \boldsymbol{0} & \boldsymbol{\lambda_{x52}} \\ \boldsymbol{0} & \boldsymbol{\lambda_{x62}} \end{pmatrix} \begin{pmatrix} \boldsymbol{\eta_1} \\ \boldsymbol{\eta_2} \end{pmatrix} + \begin{pmatrix} \boldsymbol{\delta_1} \\ \boldsymbol{\delta_2} \\ \boldsymbol{\delta_3} \\ \boldsymbol{\delta_4} \\ \boldsymbol{\delta_5} \\ \boldsymbol{\delta_6} \end{pmatrix}$$

If the unobserved variable is treated as independent ("exogenous"), the notation tends to shift. This is an example of a measurement model with two unobserved variables η (latent) with error $\boldsymbol{\delta}$. Factors are treated as perpendicular (orthogonal). This means that all other cells are set to zero, and hence, no cross loadings are allowed.

To obtain the factor solution, the software uses systems of equations and the method of substitution to produce a solution. Using confirmatory factor analysis, I can model the variance $\boldsymbol{\sigma}$ and covariance $\boldsymbol{\sigma^2}$ of behavioral items in the survey to compute a latent variable $\boldsymbol{\eta}$ from the survey items $\boldsymbol{x_i}$. The variance-covariance matrix includes the item variances on the diagonals and covariance between pre-specified items.

	x_1	x_2	x_3
x_1	$\boldsymbol{\sigma}$	0	0
x_2	$\boldsymbol{\sigma^2}$	$\boldsymbol{\sigma}$	0
x_3	$\boldsymbol{\sigma^2}$	$\boldsymbol{\sigma^2}$	$\boldsymbol{\sigma}$

How does this work? In a one-factor model **F1** with three variables **X,** you derive $\boldsymbol{\lambda}$ by multiplying the covariance between the first **X** and second **X** with the covariance of the first **X** and the third **X**. Then, you divide for the covariance of the second and the third **X**. The rest is linear algebra.

$$\boldsymbol{\lambda_1 = \frac{\sigma(x_1,x_2)\sigma(x_1,x_3)}{\sigma(x_2,x_3)}, \lambda_2 = \frac{\sigma(x_1,x_2)\sigma(x_2,x_3)}{\sigma(x_1,x_3)}, \lambda_3 = \frac{\sigma(x_1,x_3)\sigma(x_2,x_3)}{\sigma(x_1,x_2)},}$$

Now, let us exemplify a structural model treating the latent variable $\boldsymbol{\eta}$ as an outcome variable or mediating variable:

$$\boldsymbol{\eta = B\eta + \Gamma + \zeta}$$

Here, $\boldsymbol{B}$ is a matrix of $\boldsymbol{\beta}$ coefficents from the mediating variables $\boldsymbol{\eta}$ to outcome variable. **Γ is a** matrix of $\boldsymbol{\gamma}$ coefficients of the explanatory variables to the mediating $\boldsymbol{\eta}$ and outcome variable $\boldsymbol{\eta}$. There, $\boldsymbol{\xi}$ **is** vector of explanatory variables. Finally, $\boldsymbol{\zeta}$ is a vector of residuals.

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