IARTEM
International Association for Research on Textbooks and Educational Media

IARTEM *e-Journal*
Volume 7 No 2

Volume 7 Number 2

Explaining variation in usage of instructional material in teaching practice: Collegial focus and teachers' decision-making power

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Abstract

The aim of this study is to describe and explain variation in use of instructional materials such as laptops, textbooks, paper-based materials, and whiteboards in teaching in compulsory education. The data consists of video recordings of 74 lessons in Swedish schools. The results from quantitative analyses confirm previous research by demonstrating that the teachers in the study distributed more time to paper-based materials than other instructional materials. These results are interpreted using field notes and video images. The regression model confirms that subject area and class size influence teachers' and students' use of instructional materials.

Keywords: teacher behaviour; instructional materials; collegiality; educational practices; sociology of education; classroom research

1. Introduction

In a series of historical case studies, Cuban found that computers were being underused and that textbooks dominated teaching in compulsory education in the

United States (Cuban, 2006; Cuban, Kirkpatrick, & Peck, 2001). Similar patterns have been confirmed in compulsory education across several educational systems (EU, 2013; Frank, Zhao, & Borman, 2004; Penuel, 2006). Although teachers had high access to computers in the classroom, they did not use them that much in teaching practice and seemed to prefer to stick with the traditional textbook and whiteboard. Despite this, Swedish policymakers have been baffled by this same tendency in Sweden. They somehow took for granted that teachers would use computers simply because the government invested a great deal of money in computer-based education (SOU, 2014,13).

The puzzle of high access but low usage of computers and the scarcity but high usage of textbooks has been described, but not really explained, in previous studies (Zhao & Frank, 2003). Accordingly, there exists a need to identify what mechanisms (causal processes) mediate material access and usage (Bidwell & Kasarda, 1980; Ingersoll, 1996; Sørensen, 1983). With this paper I want to bridge the gap by both describing and explaining variation in usage of instructional materials such as textbooks, computers, whiteboards, and paper-based materials in teaching practice. This issue is also socially and politically relevant since the extensive amount of time and money spent on instructional materials has consequences for students' learning opportunities. Therefore by explaining the low usage of computers and high usage of textbooks we also gain a better understanding of the distribution of learning opportunities in schools (Dreeben & Gamoran, 1986; Gamoran, Secada, & Marrett, 2006,; Hallinan, 1988, 2004).

With this article I intend to make three contributions to the sociology of teachers' decision-making power and action (Bidwell, 2001; Ingersoll, 1996). First, I will present descriptive data on how teachers and students use instructional materials in Swedish schools. Second, I will present regression models to explain variation in usage of instructional materials in teaching practice. Third, I will make a theoretical contribution by identifying a mechanism-based explanation for the use of instructional materials. By mechanism I refer to the process mediating between cause and effect (Hedström & Ylikoski, 2010).

Since my empirical data comes from Swedish compulsory education, I will begin by giving a brief introduction to the Swedish case in the next section.

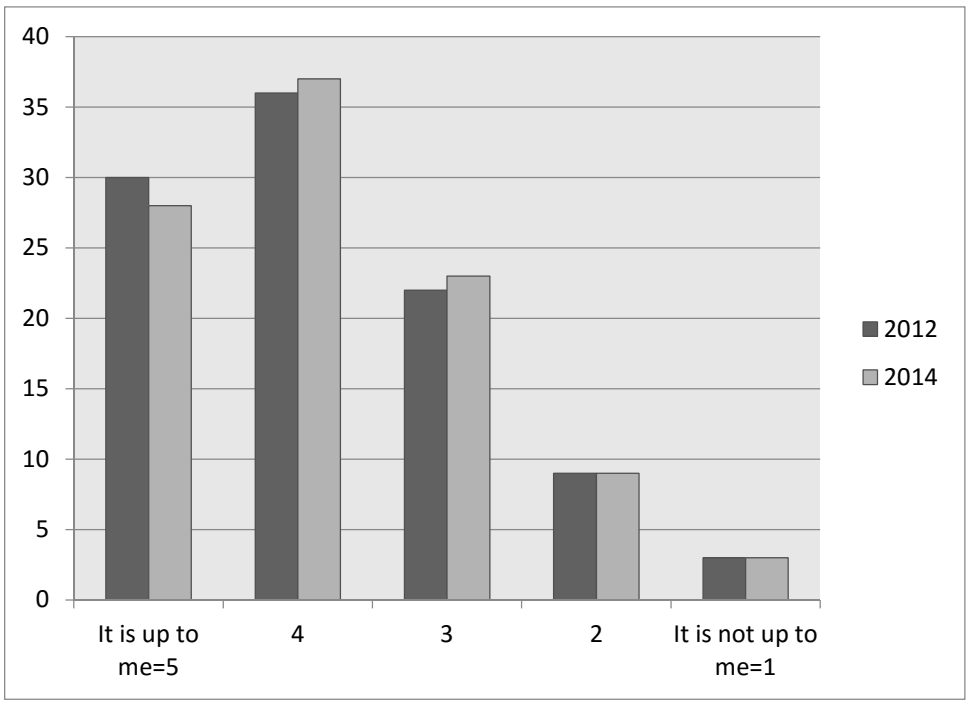
1.1 Background: The Swedish context of instructional material practice

From 1938 to 1991, the Swedish state exercised formal control of instructional materials in compulsory education. During this period a government instituted

committee was responsible for legally approving textbooks and other materials (Johnsson Harrie, 2009). The committee approved instructional materials based on: (a) the price; (b) the content area; (c) value-neutrality; and (d) the design. In 1991, the state decided to abandon this formal regulation and the responsibility for selecting materials was thereby delegated to the teaching profession and local schools. The decision was just one part of the decentralisation of the Swedish educational system that took part during the 1990s, which delegated economic responsibility to the municipalities and instructional responsibility to the teaching profession from the government (Lindblad, Lundahl, Lindgren, & Zackari, 2002).

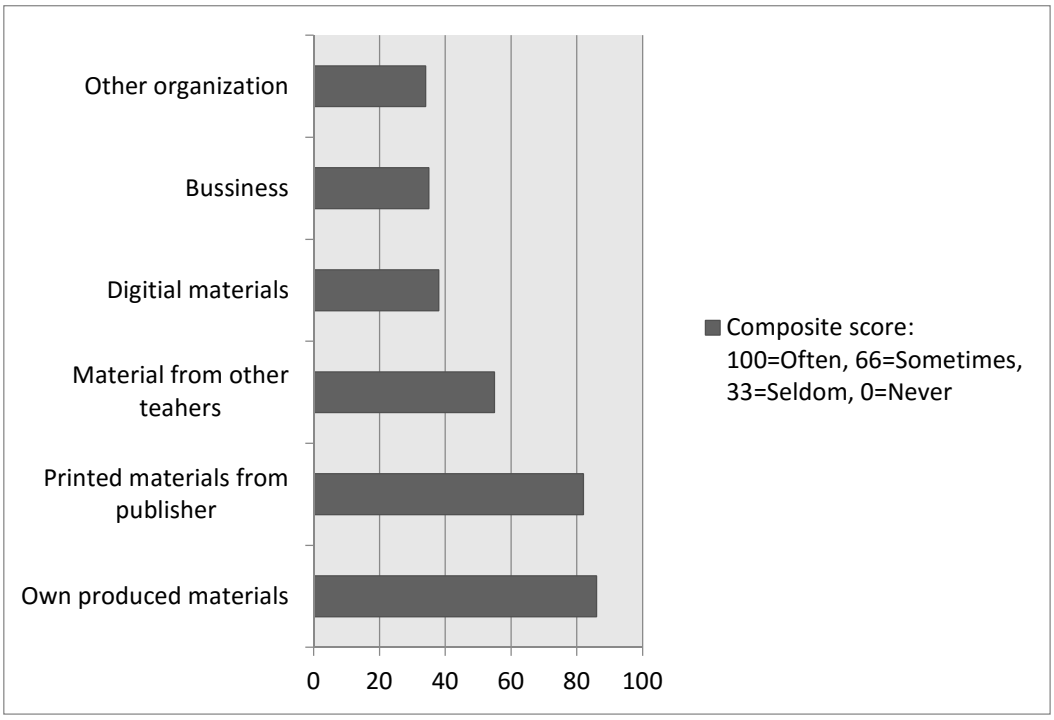
Subsequent to the decentralisation, Swedish teachers report a high degree of perceived control over the usage of instructional materials in teaching practice, as recently showed in a report by the Swedish Teachers Union (Union, 2014).

Figure 1. Swedish teachers' perceived control of the usage of instructional materials used in teaching practice (Source: Swedish Teachers Union (2014))



Furthermore, the report also suggests that Swedish teachers use both printed materials from textbook publishers and their own materials to a considerably high degree. In addition, teachers are also quite influenced by collegial advice about instructional materials.

Figure 2. Teachers' reported usage of instructional materials (Source: Swedish Teachers' Union (2014))



The usage of digital materials and computers is, however, quite low. These findings are in line with the European Commission's *Survey of Schools: ICT in Education* (EU, 2013). The EU report found that Sweden together with Denmark currently has the highest access to ICT (internet communication technology) in schools in grades 4 (91%) and 8 (91%) as well as the highest laptop to student ratio. However, according to the surveys, Swedish teachers only used computers and ICT 54% of the time, which approximates the EU average (53%) but is far below Denmark (70%).

1.2 Research questions

The overall aim of this study is to describe and explain variation in use of instructional materials in teaching practice. More specifically I will analyse how and why time in teaching practice is distributed to: (1) textbooks, (2) laptops, (3) whiteboards, and (4) paper-based materials. The data described and analysed is primary material consisting of video recordings from 74 lessons and field notes taken during the recordings of these lessons.

2. Previous research and theories

Most previous studies discussing instructional materials take as their point of departure how teachers are caught up in old habits of teaching by the textbook. Teachers are seen as reluctant to use computers or laptops, because such materials force them to change their teaching practice. Whereas textbooks are associated with the traditional teacher-centred teaching practice, computers are to a high degree associated with a more progressivist and student-centred teaching practice (Becker, 1994; Belland, 2009; Windschitl, 2002; Windschitl & Sahl, 2002). As a consequence, the usage of computers in teaching practice would require traditionally oriented teachers to adapt to more flexible and student-centred teaching practices.

The above research has focused mostly on evaluating the policy of instructional materials in schools, and has not attempted to identify the mechanisms that influence teachers' decision-making regarding what materials to use. There are, however, two theoretical explanations in previous research that attempt to explain why teachers decide to use one instructional material over another. The first focuses on structural features of instructional groups, drawing on Sørensen's theory of allocation mechanisms. The second emphasises the impact of the collegial focus, drawing on social capital theory. In the next sections I will discuss the two theories further.

2.1 Structural effects and allocation mechanism

The first theoretical explanation of relevance for the usage of instruction materials in teaching practices was offered by Sørensen (1983). The argument is that learning opportunities, i.e., the rate of exposure to instructional materials, is constrained by the size and ability of instructional groups. The greater the number of students, the more difficult it will be for the teacher to keep their attention. Furthermore, the more students there are in the classroom, the less time and energy can be allocated per student by the teacher. Consequently, teachers have the decision-making power to allocate time to different instructional materials, which may mediate the required knowledge to the actual group of students in the classroom (Barr & Dreeben, 1983; Hallinan, 2004; Sørensen & Hallinan, 1986).

Moreover, Sørensen's (1983, p. 204) argument draws on Weber's (1983, p. 31) distinction between social relations as either "open" (i.e., free participation) or closed (i.e., constrained participation). Sørensen suggests that: (1) classrooms are closed social relations because the number of learning opportunities,

exposure to materials, are constrained by the size and ability of the instructional group. The constraints imply that: (2) the duration of learning opportunities cannot be equal across students. Therefore: (3) the teacher has the decision-making power as he/she is responsible for allocating time of exposure to materials for students. In this sense the size of the instructional group is the cause that forces teachers to make decisions about how to allocate time, energy, and learning opportunities to students. However, Sørensen adds that teachers' decision-making power is compromised by their capacity to engage students and deal with student disengagement. The teacher's capacity to engage students is related to the ability and effort of the students. The latter idea has been verified in quantitative ethnographic studies (Eder, 1981, 1984).

Another case of closed relationships and hence restricted participation is the collegium of teachers (Bidwell, Frank, & Quiroz, 1997), which brings us to the next theoretical explanation of use of instructional materials in teaching practice.

2.2 The collegial focus as an interaction mechanism

Another theoretical explanation of variation in the usage of instruction materials claims that collegiality is a key factor influencing teachers' decision-making. The colleagues of a teacher shape his or her reasoning more than the school management, because teachers have more interactions with colleagues than with the principal. As such, interacting with colleagues can be a way of exchanging pedagogical advice or co-planning lessons (Frank et al., 2004; Kelchtermans, 2006; Penuel, Riel, Krause, & Frank, 2009; Zhao & Frank, 2003). In particular, it is reasonable to assume that teachers within the same subject area are also more prone to interact, since they share the same professional training and experiences. Therefore interactions within the subject area provide teachers with a professional identity and promote loyalty among teachers. Furthermore, collegial interactions within the same subject area lead to teachers exchanging advice, approval, and disapproval concerning instructional materials (Ballet & Kelchtermans, 2009; Erixon, 2010; John, 2005; Kelchtermans & Ballet, 2002; Penuel, 2006). Interactions with colleagues also influence teachers' reasoning about the benefits and constraints of instructional materials. For example, if your colleagues tell you that this textbook works well with the students you are likely to attach benefits to it because your fellow teacher has approved it and vice versa. As such, your reasoning is bound to your collegial interactions within the subject area. Through interacting with colleagues within the subject area teachers gain access to information about the pros and cons of different instructional materials (Diamond, 2007; Moolenaar, Sleegers, & Daly, 2012;

Spillane, Hallett, & Diamond, 2003). In summary, the collegial focus is an interaction-mechanism explaining the usage of instructional materials in teaching practice.

2.3 Predictions based on previous theories and research

Previous surveys and ethnographic studies have demonstrated that teachers' interactions with colleagues predict their use of instructional materials (Frank et al., 2004; John, 2005; John & Sutherland, 2005; Zhao & Frank, 2003; Zhao, Lei, & Frank, 2006). These studies show that the rationale of teachers' use of instructional materials is due to their collegial interaction within a subject area. As such, I predict that the usage of instructional materials in teaching practice will vary between school subject areas. This variation can be interpreted as a proxy for the mechanism of the collegial focus due to interactions within the subject area.

Furthermore, I predict that class size will have a positive effect on coefficients of the usage of textbooks in teaching practice. Using the textbook is a way for the teacher to allocate time equally towards students, as time and energy is constrained by the increasing size of the instructional group. In contrast, I predict that class size will have a negative effect on the usage of laptops in teaching practice. Teachers and students will work with laptops more when the class size is small, because then the teacher can be more flexible and has time for one-on-one interactions with students.

3. Method

3.1 Participants

Data was collected during the spring and autumn of 2013 in four school classes on the west coast of Sweden. The schools were sampled based on student population. One school class was recruited from a small school situated in the suburbs. The second and third school classes were recruited from an average-sized school in the suburbs. In both schools' populations, 95% were first or second generation immigrants. The fourth school's class was recruited from an average-sized school in a small town with a student population comprising 12% first or second generation immigrants. The school classes ranged from grade 4 to 8.

3.2 Data collection

The data collected consisted of 74 video recordings of lessons and supplementary field notes taken during the recorded lessons. The video recordings were imported into a computer and synchronised to create one movie. Two high definition camcorders were used (Canon Legria HFM56 and Canon Legria HFM46). The first camera held a stationary focus upon the students. The second camera was manually managed by the author to focus on the teacher. Thus, if the teacher moved from the board to the students' desks, then the camera followed the teacher-student encounter and not the student-student encounter. If the lesson was split up (e.g. for group work), then the recordings focused on the classroom. Recording focused on several subjects (mathematics, language, arts, crafts, social studies, and science). Due to insufficient recordings, however, craft was dropped from the study to avoid unequal variance.

3.3 Coding procedure

The software Observer XT 11.5 was used to code the data (Zimmerman, Bolhuis, Willemsen, Meyer, & Noldus, 2009). I developed a coding schema in which the practice of material use was treated as a social and collective action (see Table 1). Teachers' use of instructional materials was coded in the following way: if the teacher was oriented towards the instructional material physically (through manipulation, gazing, gesturing) or explicitly referring to the instructional materials in speech for the purpose of instruction, this was coded as material use. Thus primacy was given to the teachers' pedagogical intention of usage.

Code for usage	Description
Laptop	Gazing or pointing at, or manipulating laptops
Textbook	Gazing or pointing at, or handling textbooks
Whiteboard	Gazing, writing, or pointing at the board, working with the board for PowerPoint presentations, projector use or movie screening.
Paper-based materials	Gazing, pointing, or writing on paper based materials (stencils, notebooks, and other papers, which may also be copies from textbooks or workbooks).
Other instructional materials	Using other instructional materials. These are infrequently used materials.
No instructional materials practice	No instructional material is used by teachers, or less than 50% of the students look at or handle it.

Table 1. Coding scheme.

Student practice of instructional materials use was coded if 50% of the participants physically present engaged in use of the instructional material. Thus the participants had to be oriented towards the instructional material physically (manipulation, gazing, gesturing) or explicitly referring to the instructional materials in speech for the purpose of school work. There had to be a collective action among students for it to be counted as a use of the material.

The inter-rater agreement of the coding was 96%. To evaluate the reliability, Cohen's Kappa was computed (Bakeman & Gottman, 1997, p. 62). Cohen's Kappa, $= \frac{\Pr(a)-\Pr(e)}{1-\Pr(a)}$, is calculated by subtracting the observed agreements Pr(a) with the expected agreements Pr(e). That number is divided by 1 minus the expected agreements. The overall Cohen's Kappa for coding reliability was high (94%).

3.4 Variables

The statistical analyses focus on two explanatory variables and one outcome variable. There, the latter is collapsed into four dummy variables.

Outcome Variables: The outcome variables of the regression models have two components; duration and event. An event is the qualitative change from one activity state to another activity state – i.e., a transition. The event variables of interest for this study were: (1) whiteboard use, (2) board use, (3) paper-based material use, and (4) laptop use.

Duration refers to length of practice of instructional materials in teaching as measured in seconds. The duration of the start and stop time was sampled as a continuous time. The onset (start) of "risk" of occurrence was defined as when the lesson began, or when the students entered through the door. The offset (stop) of "risk" of occurrence was defined as when the lesson ended, or when students had left the classroom. However, as "risk of event" is linguistically awkward, I will use the less technical term "transition intensity".

Explanatory Variables: I treat the school subject area as a factor variable. This variable contains three levels: language, social studies, and math/science. This reflects the distinction between humanistic, social, and natural science. The distinction is perfect; however, school subject area was used as a proxy variable for interactions due to the influence of the collegial focus on the usage of instructional materials in teaching practice. Teachers within the same subject

share a common professional training and thus a common professional identity and solidarity. The variable is also to proximate teachers' collegial interactions.

Class size is used as a proxy variable (i.e. a close substitute) for the increased constraints (cost) of using certain instructional materials in teaching practice. I treat the variable as a numeric variable for the number of students present in the classroom.

3.5 Analytical strategy

First, I used descriptive statistics and field notes and video images to describe how much of the time instructional materials were used in teaching practice. Second, I used regression models to explain the variation in transition intensity in the usage of instructional materials in teaching practice. The analytical strategy was to capture the use of instructional materials in teaching practice as social action and to identify the causal processes at work. As such, I wanted to describe the sequential structure of action (hereafter; transitions) and hence advance a process-based explanation (Gross, 2009; Hedström & Ylikoski, 2010; Katz, 2014; Lichterman & Reed, 2014; Tavory & Timmermans, 2013).

To capture social action it is important to consider the action of deciding between using and not using a latent categorical variable, as discussed in the previous sections. In addition, I theorise social action as not only a matter of regularity (frequency) but as a matter of duration. While actions like "taking turns to talk" in conversation happen rapidly, the gross physical action of using materials is marked by longer durations (Gibson, 2008). As such, I wanted to focus on durations in the descriptive and analytical data analysis.

Furthermore, using OLS-estimates for events would lead to sampling on the dependent variable because censored observations are ignored. As such, I specified a stratified Cox model (Blossfeld, Golsch, & Rohwer, 2007).

$$h_k(t_i|x_i) = h_{k0}(t_i)\exp(\beta_1 Subject\ Area + \beta_2 School\ Class) \qquad (1)$$

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 variables X occurs. Furthermore $h_{k0}(t_i)$ is the expected baseline of the hazard function in the strata **K** (school class). Moreover, **exp** is the exponent of the coefficient **B** for the explanatory variables.

This gives the instant hazard rates. Such rates are difficult to interpret. A more sensible way is to use hazard ratios. To do so the equation is reorganised; $\frac{h_k(t_i|x_i)}{h_{ko}(t_i)} = \exp(\beta_x)$. Take the exponent of the coefficient and thus we can interpret the coefficients as ratio of the hazard when X =1 relative to the baseline when X=0. That is the interpretation is always comparative (relative). The ratio of the hazard is kind of like the odds ratios in a logit model, i.e., multiplicative.

To fully capture the processes leading to the usage of instructional materials in teaching practice, I needed a way of interpreting the meaning of teachers' and students' actions. Consequently, I supplemented the quantitative coding and statistical analysis with a qualitative analysis of field notes and video images to make a detailed description of processes to be able to interpret them. I selected field notes and images strategically to verify the interpretation of the quantitative evidence. Critical aspects were identified in the images with "circles". Moreover, to maintain the anonymity of the participants I converted the video images to "line drawings". In addition, all teachers and students were given fictitious names.

Currently, there are no systematics for gross physical actions as there are for "taking turns to talk" (Gibson, 2008). "Taking turns to talk" is about the "organisation of social action" (Schegloff, 1987). To focus on transcripts about usage would be a problem of "descriptive validity" because the analytical foci would shift the description "organisation of social action" away from the description of social action as such. There are specific aspects of social action that are visually meaningful.

4. Results

I begin with presenting descriptive statistics, images, and field notes on the distribution of time to usage of instructional materials in teaching practice. Thereafter, I continue by explaining the variation in usage of instructional materials in teaching practices by fitting regression models to the data.

4.1 Describing usage of instructional materials in teaching practice

Table 2 represents the time distribution of instructional materials in teaching (computers, books, paper, and boards) for teachers and students. Students' use, in order, was as follows: pen and paper (40%), books (20%), and laptops (8%). Teachers' use, in order, was as follows: paper-based materials (18%), boards (12%), books (8%), and laptops (6%). The rest of the time no materials were used

in teaching practice. Teachers did not use instructional materials 54% of the time, and students did not use instructional materials 29% of the time.

Actors	Actions	F (No. of events)	Duration (% of total time)	Mean (Duration)	S.D. (Duration)	S.E.
Teacher	No instructional materials	1522	54.29	76.18	206.40	5.29
	Laptop	274	5.50	42.90	189.44	11.44
	Textbook	200	7.61	81.26	203.53	14.39
	Whiteboard	843	12.29	31.14	92.57	3.19
	Paper-based materials	462	18.38	84.96	239.41	11.14
	Other instructional materials	52	1.92	78.99	182.67	25,33
Students	No instructional materials	211	29.26	296.16	464.86	32.00
	Laptop	18	7.52	891.85	924.51	217.91
	Textbook	44	19.55	949.05	944.59	142.40
	Whiteboard	21	0.46	46.76	46.69	10.19
	Paper-based materials	104	40.32	827.89	889.28	87.20
	Other instr. materials	10	2.89	617.70	910.49	287.92

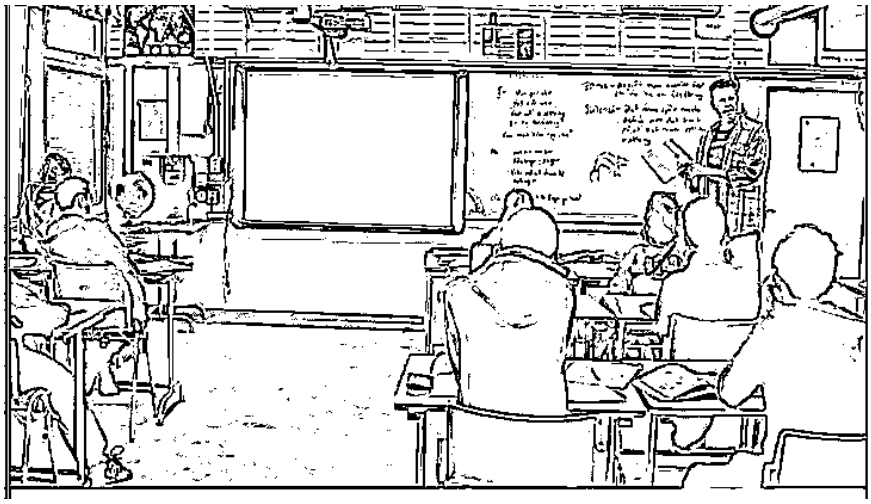
Table 2. Descriptive data of the usage of instructional materials in teaching.

Overall, these results indicate that these teachers have abandoned the traditional teacher-centred rigid teaching practice associated with the textbook. Instead, the teachers seem to prefer a student-centred, flexible teaching practice using paper-based materials that the teachers have copied themselves from various textbooks and webpages. I will elaborate on this finding in the following paragraphs.

Textbooks and whiteboards are associated with a traditional teacher-centred teaching practice. When teachers use the textbook or whiteboard they tend to stand in front of the class to recite or lecture, as can be seen in Figure 3. In Figure 3, the teacher, George, is pointing towards a specific paragraph in the textbook that the students are to pay attention to. Standing in front of the classroom means that George can see that the class is collectively following along with the teacher in the textbook. That is because the teacher can easily spot if the student is

following along by looking at the textbook or if the student's attention is wandering away to peers.

Figure 3. Use of textbooks in teaching practice.



Furthermore, being close to the whiteboard makes it convenient for the teacher to write up key concepts in the textbook that the students are required to learn. For example, the teacher, George, has written about "insurance" on the board. Alternatively the teacher writes down words from the textbook that the students do not comprehend. This means that the teacher is in control of the selection and pacing of the exposure to the instructional material. Thus, little leeway is given for students to explore the material; however, all students have the same exposure to the material.

In contrast to this teacher-centred practice, paper-based materials are frequently used with a more individualised focus, i.e., they are student-centred. The paper-based materials consist of copies of textbooks or webpages, which makes a more flexible teaching practice possible. Another reason for their prevalence may be that the schools tend to approve of just one textbook, and that may not meet the teachers' expectations of what benefits the students (Field notes, May 28, 2013). For example, one teacher, Mindy, told me that finding the right materials for the students was a balancing act. On the one hand, she wanted to stimulate cognitive growth according to the students' individual abilities. On the other hand, Mindy believed that students preferred to work with rote learning exercises. This was not, however, an individual teacher concern, but a collegial one. Mindy told me that the mathematics teachers in the whole school district had agreed upon how to handle the problem when they met at subject area conferences (Field notes, April 13, 2013).

When paper materials are used, the teacher frequently moves around the classroom instead of being positioned at the front. Teachers and students thus used paper-based materials primarily during seatwork while having one-on-one interactions. This allows the teachers to work more flexibly with the students. Thereby, the teacher can oversee the work and progress of the individual student and interact on specific problems, as can be seen in Figure 4 where Mindy is working closely with a student in mathematics class.

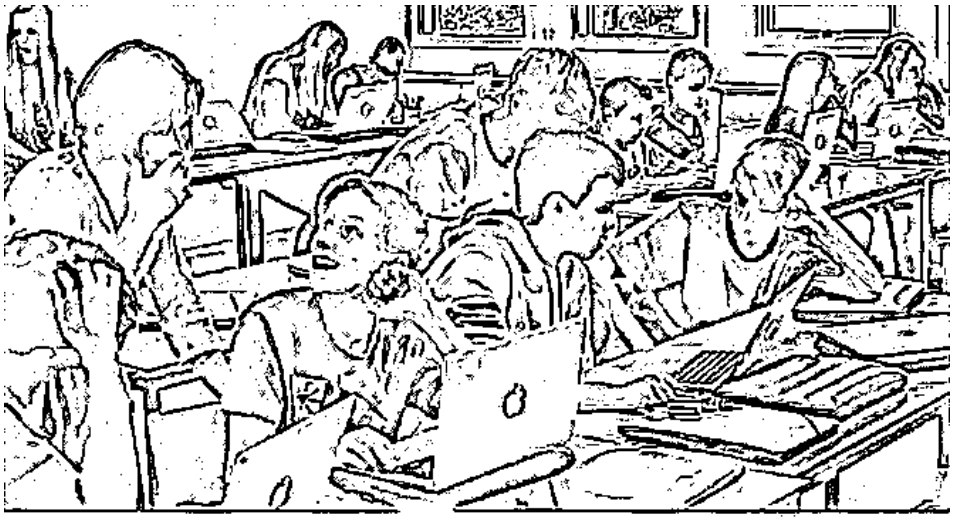
Figure 4. Use of paper-based materials in teaching practice.

However, the teacher is not in control over the pacing of instruction when using paper based materials. Student can work at their own pace, and thereby gain a certain degree of control over the selection as they have more leeway as to what to focus on. Therefore, the teacher is not in a position to make sure that students have equal exposure to the materials used nor able to give all students the equal amount of interaction time (Field notes, May 30, 2013).

Similar to paper-based materials, laptop usage in teaching practice is also student-centred. Working with laptops gave the students leeway to explore and thus the opportunity for greater individual learning. For example, in Figure 5, another teacher, Penelope, is working one-on-one with students. The students are working with PowerPoint presentations about American food culture and are enthusiastic about showing Penelope an image of an overweight American. Penelope covers her mouth to mask her emotional reaction to the unexpected image. Obviously portraying stereotypes was not what the teacher had intended and thus demonstrates the unexpected risk of having the students work with laptops (Field notes, May 30, 2013). Penelope also told me that she was constantly worried that the students would get distracted when working with

laptops, i.e., there is a risk that the pacing and selection made by the student tends to get “too free” with computers, as compared to the more constrained paper-based materials. The laptops have, however, been supplied by a municipal program, One-Laptop-Per-Student, and the teacher therefore feels pressured to use them (Field notes, September 3, 2013).

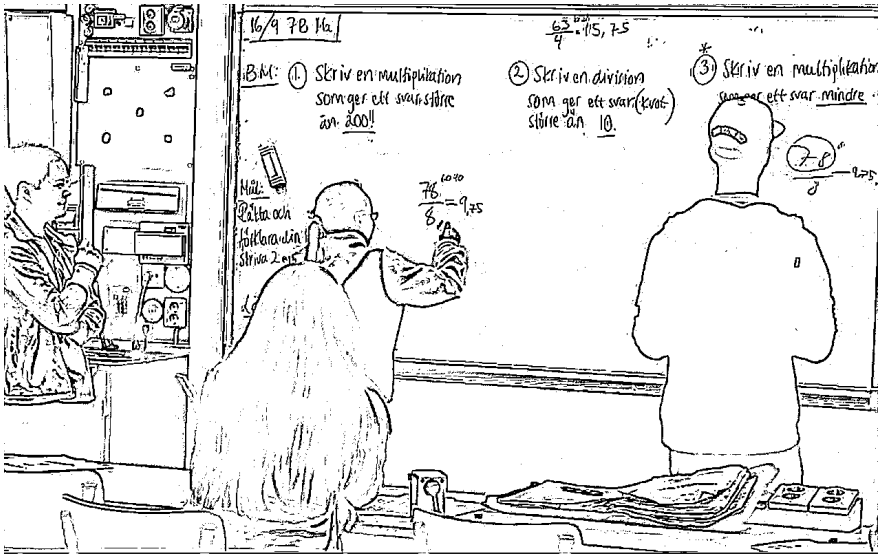
Figure 5. Use of laptops in teaching practice.



As discussed above, the whiteboard is traditionally viewed as a teacher-centred means of instruction. However, student usage of the whiteboard does occur, even if it is more seldom. Students use the whiteboard mainly when they are to present their work in class. For example, teacher Mindy had her students writing up solutions to fractions on the whiteboard. Her pedagogical intention was to make the teaching more student-centred and thus more fun. The reason that the students rarely get to present at the board is because it is seen as a risky teaching practice. Even though this gives an opportunity for student-centred teaching practice, there is a problem in that students differ in ability. In Figure 6, the student Amala was solving the fraction easily while Abukar was struggling. Teacher Mindy avoided remarking on Abukar in front of the class but suggested that Amala help her peer. Instead Amala rolled her eyes and gave Abukar a smirk indicating contempt over his inability to solve the problem and the class followed her initiative by starting to remark.

My interpretation is that rare events of student board usage occurred because there was an opportunity for the teacher to engage the students more. However, the teachers learned that such student-centred practice was costly in terms of student engagement.

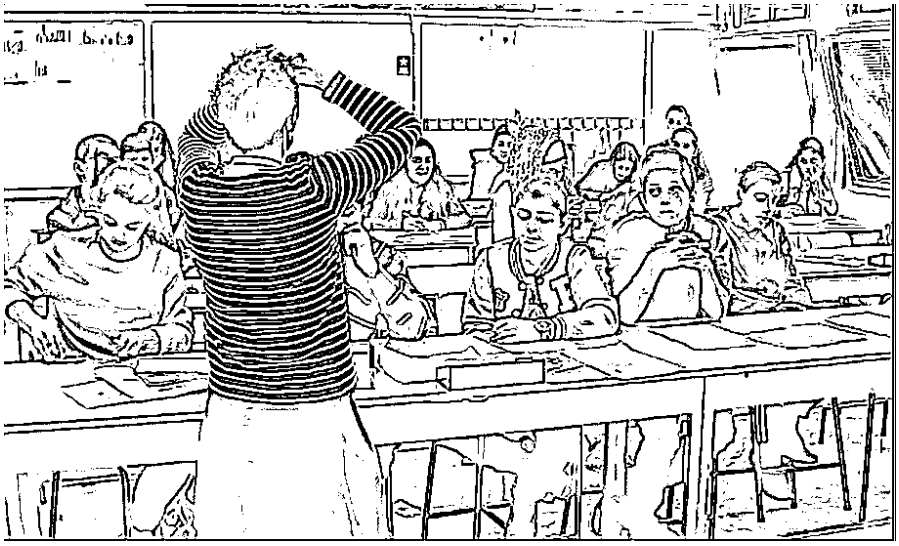
Figure 6. Student use of whiteboard in teaching practice.



In summary, different instructional materials are associated with different forms of teaching practices. Accordingly, the teacher's decisions about instructional materials influence both students learning opportunities and the teacher's control over the focus and pacing of student work. Thus, teachers have to make decisions about what to prioritise. By focusing on the textbook students have equal exposure to the material because the teacher selects, paces, and monitors the students. This gives little leeway for students' own exploration and offers limited flexibility. In contrast, focusing on paper-based materials and laptops implies that the teaching practice gives more leeway for the student to explore and teachers to be flexible. However, the teacher loses control over the pacing and the selection of materials. Therefore there is a trade-off in teachers' decision-making.

At this point the reader may ask what happens when no instructional materials are being used. One cause for the observed non-usage time was the problem of student disengagement. As can be seen in Figure 7, all the students had paper-based materials in front of them. However, the majority of the students were not paying any attention to the materials. This made the teacher, Mindy, so frustrated that she is seen pulling her hair. One possible interpretation is that as a teacher you have control over what instructional materials students are exposed to, but that does not imply you will succeed in engaging the students.

Figure 7. Non-use of instructional materials in teaching practice and student disengagement.



4.2 Explaining the usage of instructional materials in teaching practice

The next step was assessing whether the teacher and student usage of different instructional materials varies across school subject areas and with class size. Accordingly, I will now review the stratified Cox model. Table 4 shows the raw hazard coefficients. Raw hazards are not intuitively meaningful and therefore I also provide the hazard ratios (HR), which are interpreted similarly to odds ratios, i.e., multiplicative. In most cases I transformed the hazard ratios into change percentage $(h(t)\Delta\ \%)$ to make them more interpretable; $100\times(HR\text{-}1)$.

4.3 Subject area and teacher-centred usage of instructional materials

In the previous sections I have shown how teaching practices and the usage of different instructional materials are connected. Table 3 gives additional support for this claim. As shown in Table 3, social studies teachers tends to use the textbook more intensively than language teachers, i.e., the transition intensity is higher for the former category of teachers $(h(t)\Delta\ \% = 34)$. Furthermore, teachers in social studies use the whiteboard statistically significantly more than language teachers $(h(t)\Delta\ \% = 43)$. Furthermore, math and science teachers also use the whiteboard significantly more than language teachers $(h(t)\Delta\ \% = 37)$.

These results can be interpreted to mean that, in comparison with the two other subject areas, teachers in social studies prefer a traditional teacher-centred practice using the textbook and the whiteboard because they want to control the

pacing and selection of instructional materials. Consequently, teachers in social studies have a stronger emphasis on subject area knowledge than on the students.

4.4 Subject area and student-centred usage of instructional materials

As shown in Table 3, language subject teachers use paper-based material statistically significantly more intensively than social studies teachers *(h(t)Δ %= 37)* and math/science teachers *(h(t)Δ %= 26)*.

The results can be interpreted as follows: teachers in language subjects are more prone to implement a student-centred teaching practice than teachers in the other subject areas. Teachers in language subjects are progressive and use the text as a means to work one-on-one with students. During these one-on-one interactions, the teachers work flexibly with the material by providing the students with comments and pointers on what can be done to improve the text. Thus, teachers in language subjects are more focused on the student than on subject area knowledge.

In summary, the results seem to confirm that the mechanism of collegial focus impacts use of instructional material. Teachers of social studies use the textbook and whiteboard for teacher-centred teaching practice. Moreover, teachers in language subjects use paper-based-materials for student centred-teaching practice. Math and science teachers are somewhere in the middle in their use of materials.

A) Teacher-centred usage of instructional materials

	Teacher		**Teacher**		**Student**	
	Whiteboard		**Textbook**		**Textbook**	
	β	**HR**	**β**	**HR**	**β**	**HR**
Class size	-0,03**	0,97**	0,16**	1,17**	0,14*	1,15*
	(-0,01)	(0,01)	(-0,03)	(0,03)	(-0,05)	(0,06)
Subject Area [a]						
Math & Science	0,36**	1,43**	0,03	1,03	-0,58	0,56
	(-0,1)	(0,14)	(-0,19)	(0,20)	(-0,51)	(0,28)
Social Studies	0,31*	1,37*	0,43*	1,54*	0,09	1,09
	(-0,1)	(0,14)	(-0,2)	(0,31)	(-0,43)	(0,47)

B) Student-centred usage of instructional materials

	Student Whiteboard		Student Laptop		Teacher Laptop		Student Paper-Based		Teacher Paper-Based	
	β	**HR**	**β**	**HR**	**β**	**HR**	**β**	**HR**	**β**	**HR**
Class Size	-0,14*	0,87*	-0,04	0,96	0	1,00	0,02	1,03	0,02	1,02
	(-0,04)	(0,04)	(-0,04)	(0,03)	(-0,02)	(0,02)	(-0,03)	(0,03)	(-0,01)	(0,01)
Subject Area [a]				-						
Math & Science	0,98	2,67	-	-	-0,01	0,99	-0,21	0,81	-0,46**	0,63**
	(-0,85)	(2,26)		-	(-0,24)	(0,24)	(-0,27)	(0,22)	(-0,12)	(0,08)
Social Studies	1,52*	4,57*	0,08	1,08	-0,3	0,74	-0,47	0,62	-0,31*	0,74*
	(-0,72)	(3,27)	(-0,66)	0,71)	(-0,17)	(0,13)	(-0,29)	(0,18)	(-0,13)	(0,10)

*sig p<.05, **sig p<.01, [a.] Language is the reference category.

Table 3. Stratified Cox regression.

(Note: Unstandardised coefficients' standard errors are in parentheses; stratified by school class.)

4.5 Class size and usage of instructional materials

While the subject area, as predicted, influences teachers' usage of instructional materials, class size influences both teacher and student usage of instructional materials. This is in line with the prediction that teachers react to larger instructional groups by allocating time to the textbook to provide equal exposure to the materials. Thus it can be observed that class size increases the transition intensity of textbook usage in teaching practice for teachers *(h(t)∆ %=17)*. Class size also increases textbook usage for students *(h(t)∆ % =17)*.

In contrast to the initial prediction, the stratified Cox model did not show any statistically significant relationship between the predictors and outcome. Rather than accepting the null hypothesis, I wanted to see if the effect was present if I did not consider the duration. Therefore, I estimated a fixed effects logit model of just the transitions (Agresti, 2007, p. 279). The left side of the equation states the probability **P** of the binary outcome variable laptop use **Y** being equal to one at time **T** for the school class. There logit is the link function. The right side of the

equation states that $\boldsymbol{\beta}$ is the coefficient for the variables class size and subject area. Each school class has its own intercepts $\boldsymbol{\alpha_i}$.

$$\text{logit}\big(P(Y_{it} = 1)\big) = \alpha_i + \beta_1 subject\ area + \beta_2 class\ size \quad (5)$$

I present the raw coefficients, the odds ratio (OR), and standard errors in parentheses in Table 4 for the teachers. The model demonstrates that the odds that teachers will use laptops are 3% larger for each additional increase in class size. I predicted that class size would have a significant effect; however, I failed to predict the direction of the coefficient. Accordingly, the effect of class size on teachers' laptop usage is thus not necessarily constrained by class size.

	Teacher Laptop	
	β	**OR**
Class size	0,03*	1,03*
	(0,02)	(0,02)
Subject Area		
Math & Science	0,07	1,07
	(0,25)	(0,26)
Social Studies	-0,31	0,73
	(0,19)	(0,14)

Table 4. Fixed effect logit model.

5. Discussion and conclusions

The puzzle of high access and low usage of computers versus high usage of textbooks and boards has been well documented in previous case studies (Cuban, 1986, 1993, 2009) and surveys (Becker, 1994). Although teachers have high access to computers, most teachers decide to use the board or textbook, which are associated with teacher-centred teaching practice. Previous studies have described teachers' underuse of computers. However, there have been few attempts to explain the variation in teachers' overall use of instructional materials in teaching practice (Zhao & Frank, 2003; Zhao et al., 2006).

This study had as its purpose to contribute to previous research by: (a) describing how, and (b) explaining why teachers do (not) use instructional materials such as laptops, textbooks, whiteboard, or paper-based materials. I hypothesised about

the mechanisms at work behind teachers' and students' actions to engage with one material over the other. More precisely, I have advanced the ideas of previous research by focusing on the role of collegial influence (John, 2005; Zhao & Frank, 2003; Zhao et al., 2006), and the constraints of class size (Sørensen, 1983).

The first contribution of my study is to confirm the previous reports that Swedish teachers make use of paper-based materials more than any other instructional materials. I interpret the findings this way: Swedish teachers want to move away from rigid teacher-centred teaching practice associated with the textbook and the whiteboard, and thus prefer a more student-centred teaching practice. However, since using computers is associated with increased constraints, the teachers prefer using paper-based materials when practicing their flexible and student-centred teaching. The teachers use a variety of different textbooks and webpages in the form of paper-based materials to vary the pacing and selection. This may be contrasted with using the textbook where the pacing and selection of the material is rigid (Grossman & Stodolsky, 1995; Stodolsky & Grossman, 1995).

Second, my study confirms that the practice of instructional materials use varies according to the school subject area. Teachers in social studies are more likely than language teachers to use whiteboards and textbooks. Both mathematics and social studies teachers are less likely to use paper-based materials than language teachers. The explanation suggested is that teachers within the same subject area cooperate because of the fact that they share, not only professional training and experiences, but also their ideas about "what works". When facing pedagogical problems, teachers are interdependent upon colleagues for support and advice. Consequently, the subject area is the important common space where teachers meet to interact with fellow colleagues to get pedagogical advice on instructional materials, pedagogical problems, and to co-plan lessons (Diamond, 2007; Spillane et al., 2003). Colleagues also become the main source of information for the individual teacher since it takes less time and effort for teachers to get information about instructional materials from colleagues at work than to explore them on their own in the classroom. My interpretation is that teachers, like other professionals, do not want to lose valuable time and effort on instructional material that fails in the classroom. Failing in the classroom implies that teachers lose respect among students. Losing respect among students leads to loss of respect among colleagues. Such respect is the main source of social capital for which teachers strive (Bidwell et al., 1997; Ingersoll, 2009, p. 174). Consequently, by being loyal to collegial opinions and advice, teachers can improve their social standings by gaining approval and respect, *primus inter pares*

(Weber, 1983, p. 189). That is why I interpret these findings as support for the argument in previous research that collegial interactions within the subject area are a mechanism that explains the practice of material use. This mechanism is ultimately an expression of teachers' decision-making power in schools that enables and constrains students learning opportunities. The alternative explanation is that teachers rely upon experience-based knowledge, i.e., what has worked in the past (Gross, 2009).

Third, my study contributes to previous research by confirming the influence of class size on the allocation of time to instructional materials. In line with Sørensen's argument, the size of the class does constrain the exposure time of learning materials and thus learning opportunities. Consequently, teachers' decisions about how to allocate time to instructional materials is constrained by class size. As the number of students in a class increases, teachers allocate more time to textbooks. Alternatively, class size may also increase the intensity with which teachers make use of computers for class teaching, but not for individual teaching. As I interpret the findings, teachers want to make efficient use of time because of their axiological concern for providing learning opportunities for the student. There is, however, also a delicate balance required in negotiating learning opportunities; between engaging students in a given task and controlling their focus on the one hand, and giving them leeway for individual development on the other (e.g., cognitive growth, creativity).

Finally I want to address the generalisability of my study. Given that my study confirms (and expands upon) previous surveys and ethnographic research, despite its small sample size, I believe it can be considered to have theoretical generalisability.

5.1 Implications

There are two policy implications that can be drawn from the study for teachers and policy makers. The first implication is that class size matters in terms of how teachers allocate time to teaching materials, but that small instructional groups do not by necessity imply more laptop usage, since there are other ways to individualise pacing and adjustment, such as by using paper-based materials rather than textbooks. The second implication is that policymakers need to consider that teachers do not always use the textbook in the traditional sense, but may pick and choose from different textbooks.

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