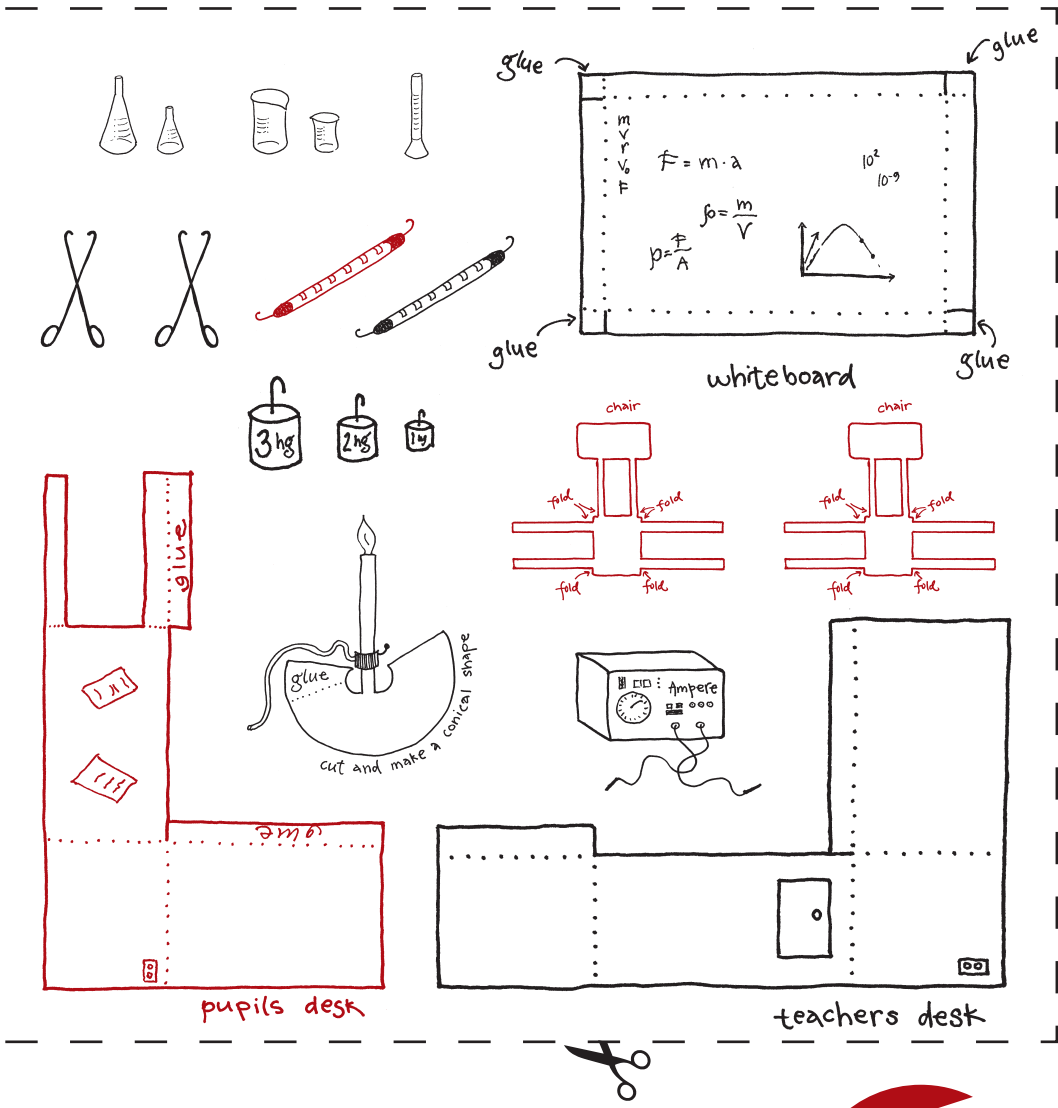# ANNA JOBÉR

SOCIAL CLASS
IN SCIENCE CLASS

MALMÖ UNIVERSITY

SOCIAL CLASS IN SCIENCE CLASS

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ANNA JOBÉR
SOCIAL CLASS
IN SCIENCE CLASS

To Ella, Thea, Sofia and Ulla

"Allt du trott var rätt är fel –
alla dina spekulationer
O brickorna i ditt spel
far omkring som falska toner
Det enda som är sant är barn,
det enda som är vackert idag
Knyt hårt o starkt era band –
led henne rätt i hennes barndomsland"

Barndomsland - Fredrik Jonsson
från Sånger från lämnade länder

"Frivilligt ska det vara, det är så fritt och tjusigt
och demokratiskt med allt som är frivilligt. ….
Det måste bli för sent, för integritetens och frihetens skull
och demokratins skull, det är viktigt.
Det är viktigare än allt.
Under integritetens och frihetens och demokratins
och ideologins hjul är det mycket som mosas,
men det är så det ska vara i ett bra samhälle.
Öppet som en tundra."

Ungjävlar - Gerda Antti

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

ABSTRACTS

English abstract

One of the most important aims of schooling is to give all children an equal education. Despite this, social differences continue to be reproduced in school. Earlier studies show that there is a relationship between low socioeconomic background of students and low achievement in science education, thus excluding many students from highly-valued education and positions in society. Building upon established sociological frameworks – particularly those provided by foremost Bourdieu and Bernstein - the overall aim of this thesis was to contribute to a more complex and multi-faceted description and analysis of inequalities in education, focusing on social class in the science classroom. Inspired by an ethnographic approach, the data was produced through observations, field notes, interviews, and a questionnaire in a Swedish compulsory school. The students, aged fourteen and fifteen, were followed during a five week unit on physics (mechanics).

Firstly, the descriptions and analyses of the school, the teacher, the student and the science classroom revealed that the knowledge threshold in the classroom has been lowered. This had been done in hidden negotiations (often with good intentions) between the students, the teacher, the sociohistorical legacy of science education, and a social discourse. It created a knowledge threshold, a lowest common denominator - which was altered not only for students from lower classes but for all the students in the classroom.

Secondly, the descriptions and analyses of the classroom communication showed that being able to translate, interpret and adapt to new or changed ways of talking increased the possibilities of understanding what ways of talking and acting that were valid or not. What also was shown was that ways of talking were created and influenced in an intricate interplay between the practices in the classroom, the teacher, and the students often in hidden negotiations. Together they constructed what ways of talking were valued and how you could act and talk in the science dialogues. In strongly controlled dialogues, more students could be heard and evaluated. However, it became a type of communication based on the lowest common denominator that in the long term might exclude all students and narrow their room to manoeuvre. Thirdly, laboratory work lessons could be lessons filled with curiosity, freedom and exciting challenges. However another picture emerged in this very common way to work in the classroom. For example, the regulative discourse totally overrode the instructional discourse and became decisive in this practical science activity. In addition, there were at least two parallel codes that needed to be translated and adapted to in the classroom. Laboratory work in this classroom was a social process that needed and was expected to be performed in groups. However, this became problematic since the grades were awarded to individuals and in addition, the reactions and the effects of a hierarchical class-marking group process became decisive.

The groups became to some extent safe havens for the students, on the other hand, undermined their chances in the classroom. Laboratory work left the students and the teacher blaming themselves even though the outcome was a result of the complex interplay between practices, the science field doxa, the curriculum, social class, school premises and educational codes.

Science learning and teaching in this classroom at its most basic was a social process and could not be correlated to, for example, inborn facilities per se nor to certain agents in the field. Social class was manifested in the science class, for instance in the dialogues or

in the laboratory work always performed in groups. However social class must be understood as collective processes and in relationship with, for example, the value that science is ascribed. It must be understood from the possibilities, limitations and the expectations the students and teacher have and how these are used. Through descriptions and analyses of social class in the science class, this thesis revealed that science classroom activities and practices and in turn room to manoeuvre and possibilities, are collective processes.

Key words: social class, science classroom, students, teacher, laboratory work, group work, dialogues, Bourdieu, Bernstein, hidden negotiations, colliding codes, social discourse, processes.

概述

学校教学最重要目的之一是赋予每个孩子同等的教育. 尽管如此, 学校再创造了社会差异. 先前的研究表明,学生的低下社会经济情况背景与自然学科成绩低下有一定联系. 这样, 不少学生在未来就被排斥在社会高端学科的教育和职业之外. 本篇论文在Bourdieu和Bernstein的理论基础上, 以自然学科课堂的社会阶级为中心, 旨在对小 学生所受的教育存在不等现象提供更多方位描述和更深层的分析. 在人种民族学的启发下, 本论文的数据取自瑞典义务小学八年级物理教室里的观察, 记录, 采访和统计调查.

1. 对教室里现象的描述和分析揭示了知识难度的下降. 这一现象的发生通常是因为自然学科的教学所具有的社会历史传统因素, 学生, 老师和教室里的谈话社交之间有无形的默契, 或被称为隐蔽的磋商, (出发点往往是善良的愿望),教室里形成了对所有学生都不利的知识难度的分档.

2. 对教室里交流的描述和分析显示, 具有对新的交流方式意会和适应能力强的学生更能理解何种课堂言行才是有效或无效的. 教室里的各方语言交流的模式的产生和发展是学生, 老师和实践操作共同作用的结果. 也就是说, 这三者一起决定了自然学科教室里有关学科内容的科学性的交流的言行举止. 在由老师掌控的对话交流中, 更多的学生可以听懂内容并进行评估. 在这种交流中老师通常选用难度较低的知识水准, 长此以往, 该种交流有把学生排除在外的危险可能, 和将来局限他们灵活操纵交流的可能.

3. 实验作业本应充满好奇, 自由, 兴奋的挑战, 但教室里却呈现了完全不同的另一画面. 形式, 设计和如何操作实验的常规介绍, 取代应有的学科内容, 概念和知识, 成了决定作业成功的关键. 此外, 在实验作业教室里的学生要意会并适应至少两种平行的密码. 学生的实验工作是社会交际过程, 需要并被要求分组进行. 但这里有问题. 由于成绩评分是针对个人的, 而且, 社会阶层标志过程 (hierarchical class-marking process)的反应和影响起了决定作用. 课堂上的小组在某种意义上成了学生的保护区, 这种保护破坏了学生的发展机会. 最后, 学生们和老师把作业差错归咎于自己或个人, 而并不意识到, 在实验课上的最终结果, 是自然学科教室里实际操作, 科学领域的信念关系, 课程, 社会阶层, 学校环境和教育密码等诸多密码复杂地相互作用的结果.

自然学科的教学, 是一个社会交际过程, 成功与否与是与身俱来的人的天赋无关. 教学过程中的语言交流和通常以小组形式进行的实验活动呈现出社会阶层区分. 这种课堂里的社会阶层区分会受到集体交际过程的影响, 学生之间关系的影响, 还有老师教学的影响. 也被该教室里师生间互给互取的机会, 局限和期望所决定. 透过对自然学科课堂上的阶级现象的描述和分析, 本文揭示了个体学生对可被灵活操纵调节的交流空间, 对学科知识, 和对权力自由的可能获得的机会是存在于一个集体交际过程中的, 需从小组全方位角度来理解.

关键词: 社会阶层, 自然学科教室, 学生, 实验操作, 小组活动, 对话, Bourdieu, Bernstein, 隐蔽的磋商, 碰撞的密码, 社会性的谈话交流, 过程.

Svensk sammanfattning
Ett av skolans viktigaste mål är att ge alla barn en likvärdig utbildning. Trots detta reproducera skolan sociala ojämlikheter. Tidigare studier visar att det finns ett samband mellan låga socioekonomiska förutsättningar och låga resultat i de naturvetenskapliga ämnena. Detta leder i förlängningen till att vissa grupper av elever utesluts från av samhället ansett som viktiga utbildningar och yrken. Det övergripande syftet med denna avhandling var att bidra till en mer komplex och mångfacetterad beskrivning och analys av ojämliketer i grundskolan med fokus på social klass i det naturvetenskapliga klassrummet. Avhandlingen tar sin utgångspunkt i en beskrivning av det naturvetenskapliga klassrummet samt teoretiska ramverk från främst Bourdieu och Bernstein. Med en etnografisk

ansats genomfördes observationer, fältanteckningar, intervjuer och enkäter i ett fysikklassrum i en år 8 i en svensk grundskola.

För det första så visade beskrivningarna och analyserna att kunskapsnivån i klassrummet sänktes. Detta skedde genom dolda förhandlingar (ofta med goda avsikter) mellan studenter, lärare, samt genom effekterna av den naturvetenskapliga undervisningens sociohistoriska traditioner. Det skapade en minsta gemensamma nämnare på kunskapsnivån i klassrummet som missgynnade alla elever i klassrummet. För det andra så visade beskrivningar och analyser av klassrummets kommunikation att de elever som kunde tolka och anpassa sig till nya eller förändrade sätt att kommunicera gavs ökade möjligheter att tala och handla i enlighet med vad som förväntades. Vad som också framkom var att sätt att tala och kommunicera fortgick och skapades i ett invecklat samspel mellan eleverna, läraren och klassrummets praxis. Tillsammans konstruerade de, oftast i dolda förhandlingar, vilka sätt att tala som värderas och hur man skulle agera och kommunicera. I starkt styrda dialoger, kunde fler studenter höras och bedömas. Dessa dialoger skedde dock på en lägre kunskapsnivå som på längre sikt riskerar att utesluta studenter och begränsa deras manöverutrymme i framtiden. För det tredje, laborationer i detta klassrum skulle kunna vara fyllda med nyfikenhet, möjligheter och spännande utmaningar. Dock framkom en helt annan bild. Till exempel, snarare än innehåll, naturvetenskapliga begrepp och kunskaper blev formen på och hur man skulle genomföra laborationen avgörande för om man klarade av att genomföra laborationen. Dessutom förekom minst två parallella koder som eleverna behövde anpassa sig till i laborationsarbete. Till exempel så var laborativt arbete en social process som behövde och förväntades utföras i grupp. Det blev problematiskt eftersom betygen är individuella. Dessutom blev reaktionerna och effekterna av sociala positioner och hierarkisk gruppuppdelningar avgörande. Grupperna blev i viss mån fristäder för eleverna men som emellertid undergrävde deras möjligheter. I slutändan lade elever och läraren skulden på sig själva trots att det som skedde under laborationerna i klassrummet var ett resultat av

ett komplext samspel mellan doxa och koder i det naturvetenskapliga klassrummet och dess fält.

Den naturvetenskapliga undervisningen i klassrummet var en social process och eventuella (miss)lyckande kunde inte korreleras till exempelvis medfödd talang. Social klass kom till uttryck i den naturvetenskapliga undervisningen såsom dialoger eller laborationer. Men social klass i det naturvetenskapliga klassrummet måste förstås utifrån kollektiva processer och i relation till det naturvetenskapliga undervisningsfältet och vad som tillskrivs värde där. Den måste förstås utifrån de möjligheter, begränsningar och förväntningar studenter och lärare ges och tas i en social process. Genom beskrivningar och analyser av social klass i den naturvetenskapliga undervisningen visade denna avhandling att aktiviteter och praktiker i det naturvetenskapliga klassrummet och i förlängningen manöverutrymme och möjligheter är kollektiva processer.

1. PREFACE

1.1 Points of departure

Some years after finishing my teacher education I began to work as a science teacher. I started to reflect on how some students experienced what was taught and moreover; why some students did not succeed? What did I do wrong? What did I say? What could I do? What should I do? In addition, I started to reflect upon the students and the specific subjects that I taught. Which students did not succeed? Why? Was it something in their background? Was it something about the science subjects? Why did some students not see themselves as intelligent or smart enough to do science? Why did schools repeatedly fail so many students in the science subjects? And consequently, when did it happen? How did it happen? I enjoyed being a science teacher, but I was concerned; concerned that science education seemed to create negative feelings, resistance and segregation. After a number of years I engaged in professional development and started to examine these questions more closely. I began to explore the sociology of education, trying to find ways to scrutinise these questions.

My own experience was that in discussing students' possibilities to succeed in science, comments like "he is gifted", "she has talent" or "she is not bright enough to be an engineer" were frequently used. Mortimer and Scott (2003), researchers in science education, made similar observations and asked similar questions:

> One of the occupational hazards of being a science teacher (and, in our personal experience, particularly of being a physical science teacher) arises when meeting people for the first time, at social functions, and announcing your profession as 'science teacher'. The tell-tale looks of dismay betray what for many people are none-too-positive experiences of learning science, 'Oh, physics was so difficult, it never made much sense to me.' Why should this be? (p. 14)

I felt the same way; why should this be? When reflecting on these problems I was influenced by the work of the French sociologist Pierre Bourdieu. I was captured by the phrase "a gift is nothing other than the feel for the game socially constituted by early immersion in the game" (Bourdieu, 1990, p. 109). Could there be other explanations for failure in school than intelligence and talent? Was there something else going on, a game or a process "outside" the student that needed attention when discussing success? Lemke (1990), another science education researcher, wrote that "the basic point of view is that science is a social process" (p. xi). What kind of consequences might that have in the science classroom? What if it is all a social process? What if we need to find other explanations that do not "individualise failures and legitimise inequalities within a structure where failure is attributed to inborn facilities" (p. 146)? With all these questions in mind, I started the research process that will be presented in following monograph.

1.2 Overall aim of the thesis

This research process starts in one of the most important aims of schooling; namely, to give all children an equal education. Despite the long tradition in the Swedish school system to contribute to an equal society, social differences continue to be reproduced in schools. Earlier research has shown that there are relationships between low socioeconomic background and achievement in school science. However there is little research regarding these relationships and how socioeconomic background is manifested in the science classroom. Building upon sociological frameworks provided in particular by Bourdieu and Bernstein, the overall aim of this thesis is to contribute to our knowledge and understanding of these

issues. Through descriptions and analysis of how ways of acting and talking are valued (or not) in the science classroom and how these ways of talking and acting can be related to social class, the aim is to elucidate the role of social class in the science class. The aim of this thesis is therefore to contribute to a more complex and multi-faceted description and analysis of inequalities in education, concerning social class in the science classroom.

1.3 Outline of the thesis

Chapter one sets the scene for my own point of departure, provides the overall aims, and the disposition of the monograph. The second chapter gives a background and a number of approaches to the relationship between socioeconomic status and science education. Chapter three starts with descriptions of definitions in focus and proceeds into the theoretical perspectives that guide this thesis. Chapter three concludes with a summary and the research question, bridging to the fourth chapter where method and methodology for the data production is presented and discussed. Chapter five, six and seven present the findings and are followed by conclusions and discussions in chapter eight.

2. SETTING THE SCENE

2.1 Results and achievements in science education

There are a large number of students that repeatedly, year after year, do not pass their science subjects (physics, chemistry and biology). The most recent figures from Sweden show that 10.4 % and 10.2 % of the students in chemistry and physics respectively do not pass[1] (SCB, 2011). Statistics also show that there is a continuous trend that students fail chemistry, physics, biology and general science[2] to a greater extent than in any other school subject.

Above all, it is amongst students whose parents have a low level of education that the merit ranking has decreased in Sweden. 95 % of students with at least one parent educated at tertiary level attain eligibility for admission to the upper secondary school's national programme. Only 55 % of the students whose parents have only compulsory school education are eligible for admission (The Swedish National Agency of Education (henceforth abbreviated SNAE), 2010). The trend is that those who tend to fail are students from families with a low level of education while those from families with higher level of education tend to succeed. SNAE (2005) concludes that it is the parents' socioeconomic background[3] that

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[1] This can be compared with for example English: 6. 2 % and Mathematics: 7. 9 %.
[2] Students that receive an overall grade in General science (Swedish: Naturorienterande ämnen (NO)).
[3] Socioeconomic background also refers to the notions socioeconomic status and socioeconomic standard.

shows the largest correlation to student performance; gender to a lesser extent; and to an even lesser extent if the student is born outside Sweden. The single most important factor that correlates with student performance is the socioeconomic background (also see Svensson, 2001, 2006). Of the factors that are included in the socioeconomic background, one of the most influential factors is the educational level of parents. For the largest group of students in Sweden, socioeconomic status and in particular parental educational level correlates with low performance.

Similar patterns could be seen regarding the science subjects as well. SNAE (2011a) reports that a number of national and international studies show that there is evidence indicating that results in science education are decreasing. The TIMSS 2007 study (SNAE, 2008) concludes that "between 2003 and 2007 the decline is more evenly-distributed in mathematics, while in science it is mostly low-performing students who represent the major decline"[1] (p. 11, my transl.). *PISA 2006* (OECD, 2007), that focused on science education, states that home background is one of the strongest factors correlating with students results in science subjects. Sweden, as well as other countries in the PISA study, shows the same results: there is a relation between home background and results (also see Mac Ruairc, 2011a).

2.2 Socioeconomic status in science education

Turmo (2004) refers to the PISA definition of socioeconomic status (SES) and states that cultural capital (in this particular study referred to as "familiarity with high-status cultural practices" (p. 288)) explains performance in scientific literacy to a higher extent than for example economic capital. He argues that there is a surprisingly strong correlation between cultural capital and level of scientific literacy, while the correlation with economic capital is weak. Turmo concludes that in the Scandinavian countries, the

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[1] Translated from Swedish: "Mellan år 2003 och 2007 är försämringen mer jämnt fördelad i matematik, medan det i naturvetenskap är de relativt mest lågpresterande eleverna som står för den huvudsakliga nedgången" (SNAE, 2008, p.11).

correlation between family economy (i.e. economic capital) and students' levels of scientific literacy is low. The correlation between cultural capital and scientific literacy is higher. A similar trend is shown by Marks, Cresswell, and Ainley (2006), who report that cultural factors in general play a more important role than other factors in most countries. Marks et al argue that due to less inequality in socioeconomic conditions in Sweden and the Scandinavian countries, cultural capital has more influence on academic performances than economic and social capital. They claim that there is no indication that cultural resources play a lesser role in mathematics and the science subjects. According to Marks et al, an academic environment increases and strengthens educational success.

The link between socioeconomic status and the science subjects is, according to The Royal Society (2008), very well established. However it questions whether this relationship has anything to do with science. The Royal Society argues that "it was usually not made clear in any of the literature found in this review whether the situation is the same, better or worse for the sciences as in any other subject areas (p. 22). Moreover, the report states that there is no clear description of the correlation between SES and science education and concludes that "no conclusive evidence has been put forward as to how exactly SES impacts on students' academic achievement, and even less on their uptake of science" (p. 3). To conclude, there are relationships between SES and science education, but knowledge about these relationships is lacking.

Socioeconomic status – a problematic concept
The concept of socioeconomic status is commonly used in educational research, not least in large-scale studies and assessments. However, several researchers have called attention to and raised questions towards the concept and its complexity. Turmo (2004) claims, for example, that there were three different forms of capital included in the PISA definition of SES: economic capital, i.e. financial resources; cultural capital which included familiarity with practices such as listening to classical music, reading books, attend-

ing the theatre; and finally, social capital, which included a social network utilized in different situations and contexts. All these components differed qualitatively and this becomes problematic, according to Turmo. In relation to the PISA results, the concept has been criticized by, for example, Mac Ruairc (2007), and Popkewitz (2011), who calls for further elaboration and critical perspectives that bring forward different contexts, comparisons and outcomes. Another large-scale study, the NELS study (see for example Dumais, 2002) from the United States, interpreted the SES variable using data concerning the level of education and occupation of students' parents and the family's income. A similar definition is provided by The Swedish National Agency for Education (2005) that takes into account parental educational level, parents' occupation[1] and if the student lives with one or two parents.

The problems of the concept are highlighted in the study conducted by Marks et al (2006). Using statistical analyses with data from thirty countries, they examined material, social, and cultural resources to be able to establish the relationship between socioeconomic background and student achievement. Material resources consisted of household assets and educational resources. Cultural capital consisted of books and cultural possession such as art and literature. According to the researchers, social capital was harder to define. Some theories, they claim, made wider judgements including parenting climate, the mothers' marital status and family size, while other included social network and relations. Finally, social capital was constructed from questions such as "how often do the student's parents discuss how well they were doing at school, does the family eat the main meal around a table, and how much time is spent by the parents in just talking to the student" (p. 112*)*.

The definition of SES varies, as well as its interpretation. In addition, SES is often correlated with other factors, such as ethnicity (Pong, Dronker and Hampden-Thomson, 2003; SNAE, 2005). Ac-

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[1] Swedish: föräldrars arbetsmarknadsanknytning.

cording to Cederberg, Hartsmar and Lingärde (2009) research demonstrates that

> Children (in Sweden) with parents born abroad in general have similar educational outcomes as children with native parents with the same kind of social background. Native parents are often in a more favourable class position and have knowledge about the education system, choose the best possible school for their children and are more able to help them with their homework (p.5).

They put forward that "ethnicity often conceals the work of class" (p. 5) and that the parent's social background should also be checked when comparing educational results.

To summarise, the conclusion is that SES in general plays an important role: in particular, the parents' educational level and what some researchers denote cultural capital. Secondly, there is a relationship between SES and science education, albeit not closely explored or described. Thirdly, questions have been raised regarding the concept SES and its definitions and interpretations. The Royal Society (2008) concludes its report by stating "there is nearly always a missing comparator. SES is also only one of several related measures of individual background. It is clearly a factor in attainment but the overall research evidence is complex and conflicting on why and how this relationship works" (p. 22). Later on I will therefore discuss and compare SES with the of concept social class, elaborating on what concept could be useful in relation to issues addressed in this thesis. In the meantime, both concepts will be used.

2.3 Perspectives on results and achievements in science education

Science subjects are amongst to the subjects where most students fail to succeed academically. However, there are many aspects from which to view students' achievements and performances: earlier studies referred to here often measure achievement in terms of

grades. If the achievement and performances of students could be seen to be equivalent to the knowledge gained according to the curriculum and measured through grades, it could also be said that more students fail to achieve the knowledge that curricula and goals state to be necessary in science than in any other subject. Currently, the societal discourse in Sweden is that science knowledge is considered to be important for the welfare state and its economic development (Nyström, 2009). When students fail in science subjects this implies that many students fail to learn what is considered to be important knowledge for society. According to Lemke (1990), one negative consequence will be that "a complex society is heading for a disaster when its basic decisions are made solely within the frame of reference of a small elite" (p. 138) and only a few will have knowledge to make decisions regarding science issues (elaborated on by e.g. Lundström, 2011).

However, a students' lack of certain knowledge is nothing negative per se. I therefore claim that the deficiency must be seen in the perspective of how achievements and a certain body of knowledge are valued and the consequences of this. For example, success in school science has been shown by several researchers to act as a gatekeeper to higher education, broadening life's opportunities for those who succeed, while limiting the future opportunities of those who fail (Broady and Börjesson, 2008; Malekan, 2008; Harker, Mahar and Wilkes, 1990). This is underscored by Gorard and See (2009) stating that "not only are students from poorer families less likely to take sciences, but those that do are far less likely to obtain high grades" (p. 93). Nyström (2009) argues, building on statistics from Sweden that

> the science programme[1] is a high-status programme, in the sense that it is the only programme which qualifies students for university courses in all science disciplines as well as mathematics, medicine and dentistry. Science students have the highest average school grades, and provide the largest share of students qualifying for university (p. 737).

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[1] Upper Secondary Programme in Sweden with focus on the science subjects biology, chemistry and physics.

The high status position implies that high-SES students that choose science education will prove to be better prepared and in much stronger positions than those who have chosen vocational studies (Goyette and Mullen, 2006). In addition, science is seen as a difficult subject, understood only by bright students, adding value to those who perform well in science (Nyström, 2009). Being a student in this high status education thus implies that you are regarded as bright and clever by friends and family, and in addition by the education system. Nyström (2007) suggests:

> The natural science discourse creates a position of cleverness which demarcates natural science students from the others. 'In there' (the natural science classroom) a shaping process starts which moulds the natural scientist by developing his or her reasoning beyond a perceived basic or 'common' level. The student inside the natural science classroom has access to mathematical, abstract, analytical and logical thinking tools not available to others. Students 'outside' are obliged, therefore, to learn by rote or by 'heart' (p. 428).

Even though teachers might have other aims, Nyström states that the science teacher often recreates ways of valuing science and the scientist in their classroom. Consequently the feeling of dominance is transmitted in the educational system and "science teaching often succeeds only too well in convincing students in that science is inherently so much more complex and difficult that other subjects that most students will never really understand science" (Lemke, 1990, p. 45). The perspectives on science education that Lemke and Nyström put forward are emphasised in an example given by Carlone (2003) who refers to an interview with a science teacher. The teacher saw "the naturally smart students" (p. 317) in the groups as the scientist types. In addition, the teacher did not identify any of the girls as being scientist types. The teacher states in one interview:

> Probably very few will go into careers in science. I could see uh Adam Lee doing something in science, I could see Steve Cousins, Jacob Richardson. Engineer. Steve could be an engineer. Henry. Definitively. He's very insightful into how things work,

> so he's got some great insight into stuff. Now those four they
> have talent. They have a raw ability in that area (p. 317).

Hanrahan (2006) claims that many teachers are immersed in the science culture and have adopted the thought that only bright students can succeed in the science subjects. The teachers therefore assume that science in general is too "difficult for all but a minority of 'bright' and/or diligent students, they accept without question the myths that school science has to be abstract and impersonal, too difficult for most students, and to appear absolutely objective, authoritative, and non-negotiable" (p. 9).

Lemke (1990) argues that when science is presented as authoritative it easily becomes just that. One consequence is, according to Lemke, that students may blame their own inadequacy for perceived failure. When science is presented as a difficult subject, students blame themselves arguing that it is their own fault and that they are not bright enough to become scientist. Lemke claims that this emphasis on individual learning contributes to the belief that every individual student are responsible for their failures and that "the ideology of individual learning, individual achievement, individual intelligence, individual self-discipline, and individual merit holds one single isolated individual student responsible for this result" (p. 80). Carlone, Haun-Frank, and Webb (2011) put forward a similar suggestion, that the equity problem in school "gets framed as *solely* an 'achievement gap' problem, the assumptions are that students have certain deficits to overcome before they achieve in science" (p. 479, authors italic). This happens even though, according to Lemke, failures are the result of students' membership of a social group (such as social class) that is not rewarded at present.

Elaborating further on how scientific knowledge is valued and the consequences of this, Lemke (1990) claims that it is "predominantly middle-class, North European values" (p. 85) that influences the science content, daily practices and sets the scene for what is valued or not. Similarly, Calabrese Barton and Yang

(2000) state that science education is strongly influenced by a white, middle-class perspective and a hegemonic practice which only values some students' experiences, thoughts and beliefs. In addition, Calabrese Barton (1998) suggests that science should not only be seen as a white middle-class practice, but as a male practice (also see Carlone, 2003). Danielsson (2009) discusses physics teachers from a gender perspective in a Swedish context. She argues that "women who choose to study physics not only make a different choice than is expected, they have chosen a discipline with higher status; that is associated with men, masculinity and masculine power" (p. 210).

To conclude, the research presented above calls for additional perspectives when elaborating on success and failures in a science class: perspectives such as how science is portrayed, described and valued, in this case as a high-status subject, highly valued in society and the educational system must be taken into account. In addition, perspectives concerning the influences from a white, male middle class practice need to be recognized.

2.4 Science education reproducing inequalities

When considering science education and social background, a picture emerges of subjects where many students fail and students from low SES are excluded. In addition, results and achievements are influenced by the way science is valued and portrayed in society which entails that students from low SES or class are excluded from, for example, highly valued education and positions. According to Carlone et al (2011), there is a risk that science classrooms become associated with elitism and inaccessibility and become "places where students become intimately acquainted with issues of power and inequity, and with the hierarchies of race, class, and gender" (p. 481).

Lemke (1990) asserts that school favours students from middle class homes and the assessment system therefore supports student that are well prepared by their family and social background.

Lemke (1990) claims that "sociologically, it is in no accident that the criteria for academic success seem tailor-made for the children of those groups in our society who have wielded the most political power the longest time (p.80). Like Lemke, Wickman and Persson (2008) underscore the relation between social class and science education. They suggest, from a Swedish perspective, that "judging by the statistics of science program in high school, the choice is still to some extent class-bound, since the science program is the most popular in the higher income strata of society in Sweden"[1] (p. 253, my transl.).

Svensson (2001, 2006) has elaborated on statistics from the Swedish school system regarding students from different social backgrounds[2] attending universities and upper secondary programs. According to Svensson, young people from working class homes are in many cases strongly underrepresented at universities. Approximately one third of all children born in Sweden during the seventies and eighties had working class background in Sweden. However, at university programs for pharmacists, architects, civil engineers, doctors, and dentists, working class students were relatively few and represent only between seven and fifteen per cent of the students enrolled in these programmes. Svensson claims that one reason for that could be found earlier on in the education system. Admission to programmes in medicine, dentistry, psychology or architecture requires a maximum or near maximum merit rating. Amongst the students with such qualifications, children from working-homes are underrepresented as relatively few have completed the science programme, the programme where the highest merit ranking could be found. Besides this, students from social group III[3] starting the Natural Science program at Upper Secondary School are strongly selected. A larger percentage from social group III abandon the programme, and among those who com-

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[1]Translated from Swedish: "att döma av statistiken för naturvetenskapliga program på gymnasiet är valet fortfarande till en del klassbundet, eftersom naturvetenskapsprogrammet är det som är mest populärt i de högre inkomststkikten i samhället i Sverige" (Wickman and Persson, 2008, p. 253).
[2]Svensson uses the notion *social background* as it is defined according to Statistics Sweden (www.scb.se) based on parents profession, where e.g. social group III consist of working class homes.
[3] The lowest social group in this particular study.

plete, the merit rankings are relatively low. Svensson mentions a few reasons: for example, which these students get far less get help with schoolwork at home. This is in itself not surprising, given that many parents in social group III lack the skills needed to provide help. The socially uneven recruitment to the natural scientists programme is, according to Svensson, particularly noticeable and

> worrying from a equality perspective bearing in mind that this is the program that provides the broadest qualification and this is where you receive knowledge necessary for further technical and scientific studies, which in turn leads to many interesting and well-paid professions (Svensson, 2001, p. 170[1]).

Like the statistics in Sweden, reports from the UK show the same pattern. Students who apply for and achieve in science subjects have a higher social class profile than the average student (The Royal Society, 2008). Consequently, science education could therefore be said to perpetuate unequal chances and science might "be a key factor in the reproduction of an unequal and unjust society" (Linder, Östman and Wickman, 2007, p. 8).

Two notions, reproduction and inequality, have been used when setting the scene for this thesis. The notion *reproduction* focuses on reproduction of social structures (e.g. discrimination on the basis of, for example, gender, ethnicity, and/or class). It should be seen as a transmission process that, deliberately or not, preserves and reproduces structures. In this context, the transmission is considered for example to maintain social and economic (visible as well as hidden) structures (Bourdieu and Passeron, 1990). It is patterns that maintain unfair differences between genders or between different groups with different socioeconomic status and social classes. Building upon Korp (2006), my interpretation is that research on the reproduction of social class must take into account both the micro level (e.g. a classroom or a family) as well as macro levels (such as discriminatory structures against women). The notion of

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[1]Trabnslated from Swedish: "oroande ur ett jämlikhetsperspektiv, med tanke på att det är detta program som ger den bredaste behörigheten och det är här man får de förkunskaper som är nödvändiga för högre tekniska och naturvetenskapliga studier, vilka i sin tur leder till många intressanta och välbetalda yrken" (Svensson, 2001, p. 170).

inequality will in this thesis be used in the same sense as Ross, Dooly and Hartsmar (2012) who define inequity between groups as being "where an identifiable population has an overall distribution of performances significantly different from the distribution of performance of the mean population" (p. 13).

Earlier reports and studies suggest that science education reproduces inequalities and in particular inequalities regarding socioeconomic background and social class. How can this be understood and described? How can the relation between SES/social class and science education be explored?

2.5 Research on reproduction of inequalities in science education

Cederberg, Hartsmar and Lingärde's (2009) report from research on different educational contexts in Europe shows that "social class positions affect school career. Social class can thus be reproduced in the educational system. This reproduction is a result of complex sociologic and pedagogic interaction between school and pupils" (p. 8). This complex relationship is underscored by The Royal Society (2008) which also claims that "the overall research evidence is complex and conflicting on why and how this relationship works" (p. 22).

Mac Ruairc (2011a) asks for an alternative approach when researching on achievements in school with respect to social groups and calls for an analysis of "how human experiences are produced, contested and legitimised within the dynamics of everyday classroom" (p. 148). What kind of research can contribute to a more complex and multi-faceted description and analysis of inequalities in education, with particular regard to social class in the science classroom? As early as 1979, Hugh Mehan stated that

> school has been treated as a 'black box' in between input and output factors. … But what actually happens inside schools, in classroom, in educational testing situations, … on practical everyday basis has not been examined by the researchers who de-

bate the influence of schools. … Likewise, if we are to understand how so-called input factors like social class, ethnicity, or teachers' attitude influence educational outcomes, then their influence must be shown to operate in the course of interaction among participants in actual educational environments (p. 4-5).

The Royal Society in the UK (2008) states in its report that none of the reviewed studies could "test the causal model between SES and participation and attainment in science" (p. 7) due to the research design. On a general education level, Ross (2009) calls for further research on socioeconomic disadvantage in relation to education. In other words, there is a need for deeper research into and descriptions of the relation between SES/social class and for this to be done in the everyday science classroom. Bearing earlier research on science education in mind, how can this be done? One way to address the equity problem is, according to Carlone et al (2011), to "examine closely the normative scientific practices that help define implicit meanings of 'science' in a given setting. Doing so positions school science as socially and culturally produced in everyday practice" (p. 479). How can this be done? What kind of theoretical frameworks are needed to be able to elaborate on these issues?

3. THEORETICAL FRAMEWORKS

3.1 Introduction

As showed in previous chapter several researchers ask for a closer study of how every day practices reproduce inequalities. Moreover, there is a need for problematizing and critically scrutinizing the concept SES in relation to reproduction of inequalities in the everyday classroom. How can this be understood, described and studied? What limitations, definitions and tools are needed?

According to a number of researchers, reproduction processes are often unintentional, hidden processes and hard to grasp. Hanrahan (2002) suspects that "any marginalisation is unintended by most if not all science teachers who presumably set out with the intention of teaching science to all their students" (p. 2). These unintended processes could be connected to the notion *hidden curriculum*. This was first presented in the USA by Jackson (1968) aiming to describe the hidden messages that teachers provided without explanation and expressed intention. It could be rules about talking or acting in a certain way, such as raising one's hand or not speaking out loud. This hidden curriculum is not something specific to science subjects; there are many hidden messages that the science subjects share with other subjects (Wickman and Persson, 2008).

Similar to Hanrahan, Beach (1999) makes no claims that discrimination due to class in different learning situations is intentional. On the contrary, Beach states that this discrimination and segrega-

tion happens without the consent of students and teachers. Segregation processes in school are often hidden and therefore not obviously discriminatory from the teachers' point of view. Building on Bourdieu, Gytz Olesen (2004) argues likewise that reproduction processes are not conscious. They are not cunning plans from dominant groups in society, but rather something much more refined since inequality according to Gytz Olesen is accepted as a natural, common phenomenon that need not be explained.

Dealing with unintentional and hidden processes has several implications for the research process. It calls for a close investigation of these issues; could it be that it seems hidden and unintentional because there has not been enough focus on this in science education research? Before going into the details of how to investigate and operationalize on social class in the science classroom and the reproduction of inequalities, some definition and limitations need to be made.

3.2 Social class

In the previous chapter, points of criticism were raised regarding the use of the concept of socioeconomic status (SES) in educational research. For example, the concept seldom takes into account a specific context with its variations, such as every day practices in a classroom. Cederberg, Hartsmar and Lingärde (2009) review the effects of different contexts and countries and suggest that this probably varies, influencing in turn which pupils are seen as socio-economically disadvantaged. The previous chapter has also revealed that there is a call to question research laying responsibility on the individual students, which could be one consequence of using SES. One option is therefore to use a definition of social class that more closely connects to the issues aims of this thesis.

Bourdieu (2010) emphasises that social class should **not** be defined by

> a property (not even the most determinant one, such as volume and composition of capital) nor by a collection of properties (of

sex, age, social origin ethnic origin – proportion of blacks and whites, for example, or natives and immigrants – income, educational level etc.), nor even by a chain of properties strung out from a fundamental property (position in the relation of production) in a relation of cause and effect, conditioner or conditioned (p. 100).

According to this definition class **cannot** be defined by what you own or a characteristic that you possess, nor a collection of these. Instead, Bourdieu claims that *social class* is defined by "the structure of relations between all the pertinent properties which gives its specific value to each of them and to the effects they exert on practices" (p. 100). In other words, social class is defined by the network of relations between all properties or characteristics. This network must be seen in the light of a specific practice and what is valued there, and in addition, the effects of this. Willis (1977) puts forward a similar proposition: "class identity is not truly reproduced until it has properly passed through the individual and the group" (p. 2). This emphasises a dualistic relation between the agents in the particular context and the structure that acts upon that context and the agents within. Willis presents it as "the dialectic of the self to the self through the concrete world" (p. 2)

An example of how this definition of social class works in relationship to its context can be seen by studying the case of well-educated immigrants in Sweden. Such immigrants often had high status in their home country but find themselves in a completely different position when arriving in Sweden. In relation to this new context they are differently valued even though they themselves have not changed. Class and class destiny are not masks that can be changed depending on context or purpose. Willis' notion takes into account the relation to the context and the effects of this. Willis furthermore argues that "the point at which people live, not borrow, their class destiny is when what is given is re-formed, strengthened and applied to new purposes (p. 2). Therefore, when using this notion of social class, focus can be put onto everyday life and its contexts; the interwoven relationships between the individ-

ual and the group, the agent and the structure, the student and the educational field.

Social class and gender issues

So far, this thesis has focused on the social background of students. Nonetheless, issues such as class, gender and ethnicity are intertwined and always deepen and complicate each other as social dividers and categorizations (see e.g. Reay, 1997, 1998). Bourdieu (2010) emphasises their close connection, claiming that "sexual properties are as inseparable from class properties as the yellowness of a lemon is from its acidity" (p. 102). Taking into account earlier discussions regarding the ways science is valued and how the science education field is dominated by male, white, middle class values, it is important to bear both the gender and ethnicity perspectives in mind.

Aspects of gender in relation to social class have been studied by for example Moi (1991). She argues that gender can be seen as a part of a field and that gender moulds and is moulded by the field, in the same way as social class in a specific field. She concludes that class and gender can be seen as belonging to the field without a need to specify a hierarchy between them. Even though gender and class are intertwined and according to Moi should neither be subordinate nor superior to each other, the focus in this thesis is social class. In line with Bourdieu (2010), one reason for this is to be able to unmask the effects of social class in the classroom since "so called independent variables such as sex, age and religion, or even educational level, income and occupation tend to mask the complete system of relationships" (p. 97).

Willis (1977) elaborates on a male, white, working-class encounter with school culture. Gender issues are consequently on the agenda. Even though Willis does not deny the importance of gender and ethnicity, he concentrates on social class "for the sake of clarity of incision" (p. 2). I will use a similar approach when describing the encounter between social class and male, white, middle-class sci-

ence education field. Gender issues are important and on the agenda, however this thesis focuses on social class issues.

Social class in the classroom

In accordance with earlier discussions, the definition of social class should be brought to life and understood in a context, - in this case, a classroom. Willis argues that "working class themes are mediated to individuals and groups in their own determinate context" (p. 2). One interpretation is that the classroom could be seen as this determinate context, complete with network, a system of properties, characteristics or features. In this system, the student has (or has not) some of these properties, characteristics, or features and/or the effects of these. The student is set in a system which values or does not value these properties, characteristics, features or their effects. At the same time, the students influence the system and what is valued (or not). It is a context where the student can "creatively develop, transform and finally reproduce aspects" (Willis, 1977, p. 2). This implies for example that student Joshua in a specific classroom can belong to the same social class as student Laura if student Joshua has certain properties, characteristics, features or effects of what is valued by both student Joshua and Laura. This in turn entails that students' relation to each other and "the social rank and specific power which agents are assigned in particular field" (Bourdieu, 2010, p. 107) are of importance.

Correspondingly, students that can mobilise a certain property, such as cleverness, are given favours and add value to themselves and the group. Other groups in the classroom can belong to other social classes where resistance adds value. One example of this process is shown by Willis:

> The lads, who did not do well in school, looked elsewhere to find status and prestige. For example, where school defined success as doing well in school, getting good grades, and behaving, the 'lads' defined success as 'having a laff', being popular with the girls, and being successful in fighting and 'thieving' (p. 309).

Together, these boys rejected the educational system and established and maintained their own social class in relation to others.

In contrast to for example Weber and Marx, class in this thesis will be used with a variety of aspects of opportunities regarding both economic as well as cultural and social resources that can be attributed to socially determined inequalities (Wright, 2003). Therefore, economic properties are not precluded; individuals with similar socioeconomic status could, in a specific context or condition, belong to the same social class. Bourdieu (2010) states "the educational capital held at a given moment expresses among other things, the economic and social level of the family of origin" (p. 99). The factors that determine socioeconomic status can therefore be factors predicting class and Mac Ruairc (2011a) argues that a student's social class can be constructed "by problematizing the relationship between material circumstances and cultural discursive practices" (p. 145). A consequence of this interpretation of class is that agents will understand, interpret and appreciate the same things:

> One can carve out classes in the logical sense of the word, i.e. sets if agents who occupy similar positions and who being placed in similar conditions and submitted to similar types of conditioning, have every chance of having similar dispositions and interest, and thus of producing similar practices and adopting similar stances (Bourdieu, 1991, p. 231).

Using teachers as a fictive example when trying to find out how social class works in the classroom; teachers as a group tend to produce similar practices and stances which have implications when the teachers meet students who share a similar upbringing and equal conditions. The student and the teacher will, for example, interpret and ascribe value to the same things in the classroom. The student, with a background of similar experiences and concepts, can more freely interact and respond to the teacher, both belonging to the same group of society, the same social class. Students with other experiences, from other conditions and ascribing values into other things might have difficulties. Social class can therefore be

seen and described when students and teachers meet in the class-room and for example engage in various patterns of communication. Bernstein (2003) argues that "class relations generate, distribute, reproduce, and legitimate distinctive forms of communication, which transmit dominant and dominated codes, and that subjects are differentially positioned by these codes in the process of acquiring them" (p. 13). Therefore, according to Bernstein (1975) "class is a fundamental category of exclusion and this is reproduced in various ways in schools, through the social context and forms of transmission of education" (p. 28).

When elaborating on social class, the context is constantly in focus (Bourdieu, 2010). The following section therefore aims to establish this particular context. What are the conditions that form this context? What are the practices? What kind of relations and what kind of positions can be found?

3.3 The science classroom

In order to elaborate on the specific context where social class is reproduced and manifested, the concept field will be used. Firstly, the concept takes into account social processes, relations, and struggles in the field. Secondly; it contributes to a delimitation of the space or structure that is of particular interest and thereby setting boundaries for the research process. A *field* is defined by Bourdieu (1998) as "a particular sector of that world" (p. 81). It could be seen as a room where dispositions and practices develop (Gytz Olesen, 2004). A field can also be compared with a kind of game (Bourdieu and Wacquant, 1992). Corresponding with the hidden and unintentional parts of aspects of reproduction, it is a room or a game that can have an implicit and unaware interior and a field is not "the product of deliberate act of creation, and it follows rules or better, regularities that are not explicit and codified" (Bourdieu and Wacquant, 1992, p. 98).

Struggles for positions and forces can be found in a field. These can either conserve or transform the field (Mahar, Harker and

Wilkes, 1990). For example, in the science education field parents could argue that the students need a text book as was the case in their own schooling. The teacher might want another form of educational practice, enabling the students to search for knowledge elsewhere. A new curriculum could have a third claim regarding the pedagogy. The science education field could therefore be said to have its own inner logic where the agents (for example teachers, parents, students, board members, politicians) are struggling over positions (Gytz Olesen, 2004). All these agents bring into the field their own rules and values which impact on and simultaneously construct the field. Every field therefore involves particular forms of rules and values, or as Dimitriadis and Kamberelis (2006) state, a capital which implies that different forms of agents have different impacts. As an effect of this, different agents will feel more or less at home in the fields.

The concept field will in this thesis be used as a more objective aspect of the analysis and form the backdrop for the following research process that studies the science classroom (Zevenbergen, 2001a). I claim that the classroom alone cannot be seen as a field. It cannot be delimited from the forces that act upon it, and its relations, practices and activities. For example, national curricula, syllabuses, parents, social and historical legacies are strong forces that act upon the classroom and without them important perspectives will be lost. The following section will therefore briefly explore the characteristics of this field, however, and it includes, in accordance with the demands made by earlier research, an everyday classroom perspective. This will be done from a Swedish school system perspective since the research process emanates from a Swedish classroom, school system and society.

One of the most influential forces that act upon the classroom is the national curriculum and syllabuses. Using the Swedish National Curricula (SNAE, 2011b) as a starting point and looking closely at the science syllabuses (physics, chemistry and biology[1]), these

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[1]In some science classrooms in Sweden there is an integration of the chemistry, physics and biology, denoted as General Science. They are timetabled and looked upon as one entity as well as evaluated

words, concepts and notions are frequently[2] used: reasoning, showing, discussing, putting questions, describing, communicating, interpreting and producing texts, using, applying, scientific methods, field studies, observations, explaining. Seen from a curricular perspective, school science could therefore be characterised as (1) a practical subject (using, apply, scientific methods, field studies, observations) and (2) a communication subject (reasoning, showing, discussing, putting questions, describing, communicating, interpreting and producing texts, explaining). This is also underscored by Wellington and Osborne (2001) stating

> The focus of secondary education has largely been on science as a practical subject, often quite rightly, for science is partly an empirical subject. But for many pupils the greatest obstacle in learning science – and also the most important achievement – is to learn its language. One of the important features of science is the richness of the words and terms it uses (p. 3).

Wickman and Persson (2008) have discussed Swedish school science, arguing that school science content includes intellectual knowledge as well as practical knowledge. Both are parts of school science. They claim the encounter between intellectual knowledge and practical knowledge is clearly typical in school science activities such as in measuring, observations and planning laboratory work. However, practical knowledge is also expressed in being able to find arguments or write reports, which emphasises that there are intersections in the characteristics.

Others may argue that there are more or other common features (see e.g. Engström, 2011) or as Sadler (2009) points out:

> I offer an interpretation of science education as it is practiced in schools … single characterization of science classrooms is necessarily simplistic and cannot do justice to what transpires in

as one entity. Sjøberg (1998) defines this as an integrated perspective. General science could be found in the National Curriculum and in Sweden it is possible to be assessed in either the three subject respectively or in General science.

[2]The Swedish National curriculum was copied and pasted into a data program which enabled comparing and counting of frequent and common words.

every classroom, many secondary science classrooms, at least in the US, do share a series of common features (p. 6).

Like Sadler, though influenced by the Swedish Nation curriculum, I have chosen to start by describing briefly two characteristics of the school science field: school science a practical subject and school science as a communication subject.

School science as a practical subject
School science makes use of practical activities in e.g. laboratory work, demonstrations and field studies. These are common and frequent activities in many science classrooms, emphasized in curricula, syllabuses, textbooks and descriptions of school science in Sweden as well as elsewhere (Sadler, 2009). This entails a number of things, but I want to emphasise three. Firstly (1), the physical space; the school science classroom is often adapted to these activities with cupboards filled with laboratory equipment, fume cupboards, sinks, stationary desks, etc. Secondly (2), it influences the way the activities are organized. Due to the physical space, the lack of material or the curricula, these activities (particularly laboratory work) are often performed in groups, making group work a common way to realise aims and goals. However, individual perspectives are present in the outcomes and the evaluation and assessment of the outcomes and the students themselves. Lemke (1990) argues that "we do not even balance our evaluation procedures between individual testing and group project work in proportion to their realistic importance in adult society. Classroom learning is social, classroom testing is individual" (p. 80). There is therefore a contradiction in the science classroom in learning as social process, and assessment and outcomes as individual processes. Thirdly (3), when doing experiments and similar activities, calculations are often necessary, bringing into the science education field the use of mathematics (Engström, 2011). This means that another subject often perceived as problematic by many students (see for example Andersson, 2011) is added on to an already difficult subject. The relationship is also accentuated by the fact that many teachers in Sweden (foremost at the compulsory level of education) are quali-

fied and employed to teach in mathematics, the science subjects and technology. Often, students meet the same teacher in all these subjects.

School science as a communicative school subject

Mortimer and Scott (2003) claim that "we believe that talk is the *central* mode of communication of the science classroom" (p. 22, authors italic). From a Swedish perspective, Engström (2011) claims that traditional physics education is characterized by a classroom consisting mostly of teacher to student communication. However, Engström goes on to argue that this is often a one-way communication. With regard to the patterns of talk and ways of communication in the science classroom, Mortimer and Scott ask themselves: "where else, other than in the classroom, does one person (the teacher) ask so many questions to which they already know the answer? Where else are words and phrases repeated time and time again during the course of an interaction?" (p. 23).

Lemke (1990) deals with language in the science classroom in very concrete ways. For example, Lemke distinguishes between different kinds of communication patterns and structural activities that are common in the science classroom. Lemke states that "all social co-operation is based on participants sharing a common sense of the structure of the activity: of what is happening, what the options are for what comes next, and who is supposed to do what" (p. 4). However he claims that this "common sense" is not shared by all students and some students fail to understand the connection between, for example, what is expected and how they are supposed to answer. They might have knowledge regarding the content but lack competence in common sense. This results in fewer possibilities in the classroom since they do not know "what is happening, what the options are for what comes next, and who is supposed to do what" (p. 4). One pattern that Lemke examines is the *triadic dialogue* (building upon Mehan, 1979)[1]. Lemke recognizes other

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[1] Similar dialogic patterns (likewise built upon Mehan, 1979) in the science classroom have been elaborated on by Mortimer and Scott (2003). The patterns are denoted I-R-E which stands for: I - initiation: normally through a question from the teacher; R - response: from the student; E - evaluation: by the teacher. Mortimer and Scott develop this to an I-R-F-R-F pattern where F stands for

forms of patterns such as debates, teacher monologues, teacher-student dialogues, his core arguments though could be illustrated in the triadic dialogues that follows a certain structure:

> Teacher Preparation
> **Teacher Question**
> Teacher Calls for Bids (silent)
> Student Bid to Answer (hand)
> Teacher Nomination
> **Student Answer**
> **Teacher Evaluation** (p. 8)

This kind of pattern becomes what Lemke describes as a kind of game played in the classroom, both by the teacher and the students. This kind of game includes certain rules which, Lemke argues, "heavily favour the power of the teacher, and this is no doubt one of the reasons why it has become such a popular style of teaching" (p. 11). The triadic dialogue exemplifies that there is often at least two different things going on in the dialogues.

> First, people are interacting with one another, move by move, strategically playing within some particular set of expectations about what can happen next (the activity structure). But they are also constructing complex meanings about a particular topic by combining words and other symbols (p. 13)

In the triadic dialogue the student needs to follow an activity structure and simultaneously construct complex meaning about the topic in focus. The student needs to understand how the activity structure is constructed and how you move in this structure and at the same time, sometimes unconsciously, "piece together the pattern of meanings that we call science content of the exchange, the episode, or the lesson" (p. 11). Lemke affirms that if they do not piece together the science content "they may learn how to play the classroom game, but they won't learn how to talk physics or biol-

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feedback, showing a chain of interaction used as a tool in understanding how the teacher is able to explore the students' ideas in a science classroom. Mortimer and Scott are not a priori concerned with what kind of students that can take part in the interaction, but state that "learning science involves being introduced to the language of the scientific community ... learning science involves learning the social language of science, or, at least, one form of that social language" (p. 13).

ogy" (p. 11). Lemke furthermore argues that the communicative patterns in science teaching are often explicit and "most implicit, 'unwritten' rules of the classroom are completely taken for granted by both the teachers and the students. Like 'laws of nature'" (p. 56). The implications are, according to Lemke, that miscommunication becomes more common and that they become harder to straighten out. The outcome may be that the triadic dialogue actually hinders student from expressing themselves regarding the content and the science. When Lemke deals with particular classroom dialogues, he also puts them in societal perspectives and maintains that "classroom dialogues directly display the power relations within which it is embedded, and those power relations derive from wider social system – they are not features of classroom or school as such" (p. 45). In doing this, Lemke introduces the dualism between macro level and micro level, and puts classroom activities in a larger context, thus corresponding with earlier expressed aims.

Like Lemke, Mehan (1979) discusses the consequences of communicative patterns. Mehan states that to participate in lessons students "must engage in interpretive work to analyze the flow of interaction and provide the appropriate behaviour" (p. 124-125). This implies, for example, that when the teacher improvises or changes strategies the students need not only to adapt to the new procedures but also interpret the new procedures. Mehan argues that "student's successful participation in classroom lessons is at least partially determined by their abilities to deal with this conflicting information" (p. 124-125). In addition, to be successful in the classroom, Mehan claims that the students "must learn the appropriate form in which to cast their academic knowledge. … They must know with whom, when, and where they can speak and act, and they must provide the speech and behavior that are appropriate for a given classroom situation" (p. 133). Science education researchers Tobin, Seiler and Wells (1999) have investigated the reproduction of social class in science classroom communication. They claim that

> student talk was often in an argumentative frame, resulting from and contributing to a mismatch of assumptions and expectations about the structure of in-class talk. A tension exists between the students' primary discourse acquired in the home and peer group and the discourse of science class (p. 185).

In concluding, Tobin, Seiler and Wells state that "with very few exceptions, the production of those enrolled in the chemistry course fuelled the cycle of social reproduction" (p. 186) when beginning the course from a level of disadvantage in comparison with other students, and in addition leaving the course with their disadvantage reified. I claim that these results support Lemke (1990) and Mehan's (1979) argument regarding the structure patterns and its consequences. In more recent science education research, this is emphasised by for example Sadler and Donnelly (2006), stating that "argumentation skills themselves should also become an educational focus. … content knowledge alone does not necessarily result in improved argumentation" (p. 1486).

School science as a prototype of science

The science content and the activities in the science classroom could in many respects be seen as launched from the academic science subject. Laboratory work, methods and equipment are typical features in science (Sjøberg, 1998). This is true of the language and communication as well. Nygård Larsson (2011) shows in her study that science subjects use a higher proportion of abstract and generalising nouns than the social science subjects. I want therefore to introduce a third feature and characteristic into this description of the school science field: school science as a prototype of science (Carlone, 2003, 2004).

For many decades there has been an on-going discussion about the character of school science, especially in relation to the academic subjects physics, chemistry and biology (see for example Hultén, 2008; Roberts, 2007). When discussing science education and its relation to the academic subjects of science, Carlone (2003, 2004) addresses its sociohistorical legacy and brings forward the notion *prototypical science*. According to Carlone (2003) this presents the

"taken for granted notions and sociohistorical legacies of science and science education that comprises the alienating nature of school science" (p. 308). She introduces science as an actor in the science education field and claims that "there is a lot of baggage associated with what makes a 'good' science education, including socially constructed notions about what science is, who does science, what belongs in the science curriculum, and how best to 'deliver' the content" (p. 308). I claim that this needs to be taken into consideration when considering science education as a field with a social class perspective.

The correlation between science education and science has also been described by Calabrese Barton and Osborne (2001). They report that "a review of the literature in science education through the early-1980s reveals that science educators perceived of themselves as being more aligned with 'science' than with 'education'" (p. xiv). Engström (2011) argues likewise in a study of physics teachers in upper secondary schools in Sweden. She claims that "physics teachers in secondary school in Sweden have in general been focusing on facts and a strong link with scientific theories and concepts" (p. 122). On the contrary, Mortimer and Scott claim that "it is clear that there are differences between real science as carried out in various professional settings, and school science, as enacted in the classroom" (p. 14). They state that school science has its own history and is subject to other forces (for example social and political) different from those of professional science. This is underscored by Hultén (2008) who claims that school must be understood as a separate and unique activity and that it is driven by other objectives and forces. Still, as we will see in following section, a number of researchers have elaborated on this relation and its consequences in the classroom.

Perspectives on school science as a prototype of science
As discussed in chapter 2.3, science is portrayed and described as a high status subject, highly valued in society and the education system. In addition, it is influenced by a white, male, middle class practice that has an impact on achievements and the way achieve-

ments are valued and measured. What does this picture entail when applying a prototypical perspective?

According to Hanrahan (2006), many science teachers have been initiated into a scientific hegemonic discourse through their education. They have not received support or resources from their education to deliver the curricula in ways other than those they were taught. Even with the best of intentions, they are in a position where it is difficult to be critical towards a discourse that was selected and rewarded them and now works as second nature to them. This implies, according to Hanrahan, that the teacher accepts the common myths about natural science (e.g. non-negotiable, only for the bright, authoritative, objective etc.). They become guardians of the natural science subject and reflect this in the classroom. This is similar to what Nyström proposes. Even though teachers might have other goals and aims, the consequence might be that "science teachers often reproduce this discourse in their teaching and communication of the subject, although they also try to build positive attitudes towards science" (p. 738).

Engström (2011) argues like Hanrahan, that physics teachers in upper secondary schools in Sweden have a traditional view of science and that "physics teachers practice teaching within the boundaries defined by very powerful socializing forces" (p. 122). Engström suggests that this has considerable consequences for teaching activities. In a subject characterised by communication and activity, how is this related to issues addressed in this thesis? One example is shown by Carlone and Johnson (2007), addressing issues of equity in science education when studying women on their way from undergraduate and graduate studies in science into science-related careers. Carlone and Johnson report that women in the research scientist trajectory were particularly focused on prototypical aspects of science. In addition, the study showed that what determined their trajectories was not competence or commitment; it was "recognition by others" (p. 1209). I therefore claim that prototypical aspects of science are important to elaborate on since they relate directly to the participant in the science classroom.

What is acknowledged and how that takes place in the science subjects is correlated to the agents; in this case the students in the field. Following this argument, Carlone et al (2011) state that

> Teachers and students carry with them models of good science student from the media, their peers and families, and in-school and out-of-school science. These models shape how students get positioned and position themselves in relation to school science. …For example, a historically stable model, circulating widely across time and space, is the "super-intelligent, geeky, white male" cultural model. This macro-level model shapes, but does not determine, who is perceived as being scientific in a given classroom (p. 464).

Another example is given by Calabrese Barton and Yang (2000) claiming that the picture of science is not aligned with the students. Earlier research shows that the most common drawing when students are asked to draw a scientist is a white man wearing his lab coat and goggles. This kind of picture, reflecting a practice that is white and male, is to be found in media and elsewhere when science is portrayed. Calabrese Barton and Yang blame the school-based practices that they suggest has led to

> an overwhelming number of students believing that science is a body of knowledge which consists of events, facts, and theories existing 'out there' (Cobern, 1996), that science is static rather than dynamic (Yager, 1990), that only the very brightest of people can do science (Lemke, 1990), that science does not connect with their personal lives (Brickhouse, 1994; Barton, 1998), and that once they fulfil their scholastic requirements, they will be `done' with science for the rest of their lives (Kahle & Meece, 1994) (p. 876).

Consequently there are implications of school science as a prototype of science. Its sociohistorical legacies have strong impact on the classroom, the learning and teaching of science and not at least how the students perceive themselves. There are forces in the sociohistorical legacies that bring into the field ways of talking and acting that impacts strongly on all the agents in the field.

Summarising social class in science class

Some common characteristics and features of this field have been described. Another way to see the science education field is through the concept of doxa. *Doxa* is defined as "the fundamental presuppositions of the field" (Bourdieu, 1992, p. 68). Doxa could also be referred to as the unconscious beliefs and values in a particular field. In other words: a game with a set of beliefs or presumptions that the players more or less unconsciously follow. Doxa indicate what is taken for granted and sometimes what we call common sense in a particular field. This concept could be of particular interest in the science education field where there are communication patterns taken for granted, practical activities (e.g. laboratory work), and strong influences from its sociohistorical legacy. In addition, this theoretical concept helps to put focus on dominating components: agents, players in the field and how these dominant positions are taken for granted and seen as self-evident (Bourdieu 1977, 2010). Since what is taken for granted, - the common sense - often is, according to Bourdieu and Waquant (1992), derived from the dominant group in the field it could be an important perspective from which to understand what is ascribed as valued in the science classroom and the outcome this entails for different social groups.

Gytz Olesen (2004) describes doxa as non-questioned conditions and perception (beliefs, norms) and power relations that are taken for granted. These are the things that everybody does and considers intuitive. Gytz Olesen gives examples from education; "you learn in school" or "your child develops when attending preschool" are opinions that everybody holds to be true and taken for granted. I claim that opinions such as "you learn through experiments", "you develop your scientific knowledge when working in teams", and "only the smartest people can be scientists" could be example of doxic statements in the school science field.

Doxa is tightly connected to the particular field (Bourdieu and Waquant, 1992) since it exists through the different strategies created through and with the agents (e.g. students, teacher, parents) in

the field and the positions they had. These strategies are based upon what these agents bring into the field. A teacher, student or a parent with what is considered to be the "right" and valuable ideas or strategies can change or maintain certain doxa in the field. A parent with influence can for example argue that "homework should be done in school" and through that change a previously taken for granted opinion that "homework should be done at home". Doxa could also be visualized in the science education field when teachers are working with syllabus development, discussing together what is valued and how it should be valued. However, in daily life, practices, activities and communication, doxa is often hidden and unconscious. The notion is therefore a helpful tool to keep focus on processes, positions, struggles, relations or stake-holders that are not outspoken, that are hidden, unconscious or taken for granted in the field. It is a way to reveal taken for granted normative practices found in science which according to Carlone et al (2011) can help us

> define promoted meanings of 'science' and 'science person' in a given setting. Identifying the meanings of 'science' and 'science person' in a setting requires a careful dance between recognizing their local production in practice and interaction and the ways larger, more powerful disciplinary traditions, history, and en-during cultural models shape and get shaped by these locally produced meanings (p. 463-464).

Definitions and descriptions made, what kind of theoretical tools can guide the research process and the analytical procedures fur-ther? In the background and introduction of this thesis a number of issues and processes have been addressed. The overall aim, though, is to contribute to a more complex and multi-faceted de-scription and analysis of inequalities in education, especially those concerning social class in the science classroom. Parts of Bourdieu's concept have already been discussed and might show a way for-ward. Wickman and Persson state that for many students, the dis-courses that are used in school are new. This, Wickman and Pers-son (2008) claim, is mostly due to the students' backgrounds and to what extent the school allows students from different back-

ground to participate. Some students come from backgrounds that make it easier to understand the discourse found in school science, while others have a background that makes school science more unfamiliar. According to Wickman and Persson this could be examined in two ways. Firstly, we can look at the student's identity; in short, how we can change the school science discourse so that more students can see science as something that concerns them. However, in this thesis I want to emphasise the other alternative. The authors suggest that cultural capital (using Bourdieu's definition) can be used as a theoretical concept in the discussion of what students bring with them into school and how their cultural capital correlates and acts with school science. Cultural capital as a notion can provide a way forward. The next section of this chapter will therefore investigate further the theory developed by Bourdieu in order to discuss and operationalize social class in the science classroom.

3.4 Operationalize social class in the science classroom

Bourdieu as a theoretical and analytical framework

Pierre Bourdieu's framework has been widely used in many different fields; however his contributions in the educational field are particularly extensive. According to Bourdieu and Passeron (1977), school plays an important role in the reproduction of, for example, inequalities. When doing research on the compulsory school, his theoretical framework is of particular interest in investigating how the school "devalues the cultural capital of the lower classes and valorises the cultural capital of the upper classes" (Mehan, 2008, p. 56). Bourdieu, Passeron and Saint Martin (1994) claim

> access to higher education, and even attainment at this level, is strongly related to success during the first years of school … In short, the game is over early, if indeed we can still speak of a game when the chances of winning are so unequally apportioned among children from different social backgrounds (p. 55).

Another reason for choosing Bourdieu when operationalizing the relation between social class and the science classroom is that according to Bourdieu, actions are always social and both shaped by and - at the same time - shaping the field. In addition, this theoretical framework takes into account dispositions (e.g. possibilities, potentials), while at the same time considering the structures that both have an effect on and are affected by the agent (see for example Broady, 1985, 1990; Dimitriadis and Kamberelis, 2006; Harker et al, 1990).

An advantage when working with Bourdieu is that he has provided both a theoretical as well as an analytical framework. It is a framework that can guide the research process from the limitation and theorisation of issues and perspectives into the analytical process of data. As Gytz Oleson (2004) claims, it is "a perspective and a conceptual machinery that can be linked to an analysis and understanding of social reality" (p. 14, my transl.[1]). Broady (1990) argues repeatedly that the concept provided by Bourdieu should be seen as research tools and concepts that "become fraught with meaning when employed in research processes as tools or rather, as searchlights" (p. 167, my transl.[2]). Cultural capital is of particular interest when investigating the reproduction of social class in school. The concepts of cultural capital and habitus are closely linked to each other, as well as to the field. The relation is summarised by Bourdieu (2010) as "(habitus x capital) + field = practice" (p. 95). In understanding practice, these concepts are essential and inseparable. The field is needed to be able to say something about the practice, and this field is constituted by and constitutes habitus and cultural capital. Every field is specific and needs to be seen as a specific case where certain cultural capital is valued and a certain habitus can be set in motion. Habitus becomes active in relation to the field (Reay 2004) or, as Roth and Tobin (2001) state regarding habitus, it "only reveals itself in reference to the particular, that is,

[1] Translated from Swedish: "ett perspektiv och en begreppsapparat som kan knytas till en analys och förståelse av den sociala verkligheten" (Gytz Olesen, 2004, p. 14).
[2] Translated from Swedish: "de får sin fulla mening när de sätts i rörelse i undersökningar, som verktyg eller kanske hellre som sökarljus" (Broady, 1990, p. 167).

in definite situations" (p. 750). The concepts are complex, so are their relationship; the following pages therefore intend to describe how cultural capital and habitus can be used in this particular research process.

Cultural capital

The concept of capital in Bourdieu's theoretical framework could be described as values, assets and resources. Capital could be symbolic, for example a title, or economic, such as money and shares. The forms of capital Bourdieu usually speaks about are symbolic, social, cultural and economic capital (see for example Bourdieu and Passeron, 1977; Bourdieu, 1991). The capital in focus here is *cultural capital*. Mehan (2008) describes cultural capital as cultural knowledge. This can include knowledge, skills, manner, norms, style of interaction, styles of dress. Turmo (2004) argues that "one of the key aspects of cultural capital is language. According to Bourdieu, language is not simply an instrument of communication" (p. 289). A way of talking, for example in school, could be used as a capital by some students that are familiar with the required language. This could imply that cultural capital enables a capacity to manage and understand codes and rules of a certain group (Månson, 2003). Consequently, there are students that have received familiarity and understanding of a certain language thus giving them advantages in school (Mehan, 2008). This might happen when children that enter school feel familiarity and confidence with the school culture; a cultural knowledge and a capital that is according to Mehan "transmitted by the families of each social class" (p. 59). Through this inherited familiarity with cultural knowledge and capital, activities and habits, some students have a greater chance of benefitting and succeeding in school. In a science classroom, students that have a cultural capital that are valued and/or could be exchanged have better chances of success due to familiarity with activities, practices, language etc. They feel confidence with the school science culture and the way the teacher talks. In other words, "those with the appropriate cultural capital are reinforced with 'success', while others are not" (Harker, 1990, p. 118).

This correlates with the conclusions drawn by, for example, Lemke (1990). Educational success in the school science field concerns not only the content but also familiarity with a way of talking and communicating (which is often in implicit patterns). Similarly, Ross, Dooly and Hartsmar (2012) claim, building upon Bourdieu; "the organisation and validation of knowledge is more important than the mere content of knowledge. It is not *what knowledge* that is important; it is *how knowledge* is validated that is significant and how its power-forming characteristics are used" (p. 10, authors italic).

Habitus

Cultural capital and habitus are closely linked to each other. In education this is exemplified by Harker (1990) who states that school takes the dominant habitus and transform it into "a form of cultural capital that the schools take for granted, and which acts as a most effective filter in the reproductive processes of hierarchical society" (p. 87). This means that a certain student's habitus could be transformed into a cultural capital that he/she can use in the school science field.

In Bourdieu's (1990) work, *habitus* is described as "a system of dispositions common to all products of the same conditionings" (p. 59). The concept habitus could also be described through the way it works and from its effects. Bourdieu states that "the effect of the habitus is that agents who are equipped with it will behave in a certain way in certain circumstances" (p. 77). This entails that a student, with his or her habitus, can act in a natural way in a certain field. The student can, for example, easily recognize and realise how to carry out laboratory work. When describing habitus, Bourdieu and Wacquant (1992) worked with the expressions "fish in water … it does not feel the weight of the water, and it takes the world about itself for granted" (p. 127) and "feel for the game" (p. 128). When behaving like a fish in water or have a feeling for the game: you tend to act, talk, walk, gesture or play in the appropriate way in that certain field where you are positioned. It is done without the need to think of what you should do or not, it is taken

for granted (Bourdieu et al, 1992; Bourdieu 2010). Therefore habitus often "operates below the level of calculation and consciousness, underlying and conditioning and orienting practices by providing individuals with a sense of how to act and respond in the course of their daily lives" (Mills, 2008a, p. 100). This theoretical concept could therefore be adapted to and work well with hidden curricula and unintentional perspectives as well as the taken for granted characteristics of the science education field.

Roth and Tobin (2001) discuss the German word '*spielraum'* (English: room to manoeuvre, Svenska: spelrum, (my interpretation and translation)) to grasp the concept. Habitus can be found in the 'spielraum', in the 'room to manoeuvre'. Having a proper, suitable or successful habitus (for the particular field) entails doing the right thing at the right moment, unconsciously. It means a developed sense of the game which implies spielraum in a certain field. I claim that habitus also could be understood in the opposite way, in situations where a student does not have a feeling for the game or lacks spielraum. It could be supported by Bourdieu (1990) who argues that *"the habitus goes hand in hand with vagueness and indeterminacy"* (p. 77, authors italics). The effects of habitus in particular field could therefore be exclusion when not having a feeling for the game, when lacking spielraum.

Of special interest with habitus is the possibility of taking into account both the macro and micro levels, simultaneously. The concept considers the individual student and their background, dispositions and possibilities at the exact same time as it considers the field and the structures that affect the field. It is a "compilation of collective and individual trajectories" (Reay, 2004, p. 434). Reay asserts that Bourdieu has developed the concept of habitus in order to bridge dualisms of, for example, the micro-macro and to demonstrate that "the body is in the social world but the social world is also in the body" (Bourdieu, 1990, p. 190). Therefore, Reay (1995) argues that when using habitus as a method, the focus is wider than the activities in the classroom and that "habitus is a means of viewing structure as occurring within small scale interac-

tions and activity within large scale settings" (p. 359). Consequently, using habitus makes it possible to elaborate on the micro level, i.e. the students and the activities in the classroom, and simultaneously having the macro level in mind. Through habitus it is, according to Hofvander Trulson (2010), possible to elaborate on how the structures in society influence a student's habitus and at the same time create the limitations for what is possible and what room you have to manoeuvre in. In other words, with habitus as an operational linking tool between the objective structure of the social world and the individual there are possibilities to study the relationship between social class and the science classroom.

Bourdieu's theoretical framework in educational research

One way to understand and find ways to apply Bourdieu's theoretical framework is to look at earlier research that uses Bourdieu's theoretical and/or analytical framework. The aim of the two following sections is to show and find inspiration in how Bourdieu's concepts (primarily cultural capital, habitus and field) have been and could be operationalized in school in general and school science in particular. Bourdieu's work is extensive: so are the many ways and contexts where it has been used. Criticism has been raised and Reay (2004) has actually stated that there has been a tendency to use his concepts as "hairspray" over research results. There are reasons to be aware of and learn from earlier research.

Starting with the notion of cultural capital, Kalmijn and Kraaykamp (1996) carried out research that examined the link between ethnic inequalities in schooling and differences in cultural capital. Using data from a study with a large number of respondents conducted in the USA in the 1980s, Kalmijn and Kraaykamp performed statistical analyses. They used key indicators of high status cultural activities such as classical music, art, museums and literature activity as indicators of cultural capital. They claim that cultural capital played an important role in the transmission of socioeconomic advantages across generations. The study indicated, for all groups and races that more exposure to cultural capital was

associated with higher levels of schooling even after background factors were taken into account.

The role of cultural capital in groups with low socioeconomic status has been used in a study conducted in the Netherlands by De Graaf et al (2000) which aimed to examine how parental cultural resources affected educational attainments. Among many findings the study showed that "parents who read frequently have linguistic and cognitive skills that were rewarded in school and can pass these educational skills on to their offspring" (p. 107). The home environment also corresponded with the school climate, contributing to an understanding of and affinity with common practices (such as reading) in school. According to the authors, this supported Bourdieu's main idea that "parental cultural capital provides children with the symbolic power which is what enables them to master the cultural codes of higher levels of education" (p. 97). In addition, the study showed that the differences in parental cultural capital were more important for children from lower and middle socioeconomic backgrounds. Parental cultural capital seemed to be of additional help especially for children from low socioeconomic backgrounds. Both these latter studies show that the factor of socioeconomic standard can be connected to Bourdieu's theories indicating that SES measurements can be a helpful tool.

Although the notion of cultural capital has been widely used, critical voices have also been raised. Dumais (2002) states that the effect of cultural capital overall is less important and "does affect educational outcomes, but in a limited way. Other variables - including habitus - are more important to grades than is cultural capital" (p. 59). Dumais used data from a larger study (NELS) aiming to combine cultural capital and habitus as well as gender and SES, in a model of educational success and outcomes. She performed a detailed analysis of cultural practices of eighth-grade students. The cultural capital variable was determined from the students' cultural activities and participation in art such as borrowing books from the library, attending musical events, going to art mu-

seums, participation in art, music and dance classes outside school. However, the habitus variable was more difficult, as Dumais states

> It is extremely difficult to represent one's habitus, or worldview, in a single variable, or even a large set of variables. However, one component of habitus is one's beliefs about the future. McClelland (1990) operationalized habitus as students' occupational aspirations, particularly whether or not they aspired to upper-white-collar jobs. I do the same here, with the dummy variable students' expectations representing whether or not the student said that he or she expected to have one of the following occupations at age 30: professional, managerial, or business; business owner; or science or engineering (p. 51).

By including the variable of students' occupational expectations, Dumais operationalized habitus, even though she recognised that this was only one small element of habitus. The analysis of the different variables showed that habitus played a larger role than cultural capital and that it was more evident regarding boys. She concluded that

> researchers must be more careful in using and operationalizing the term cultural capital and more willing to consider the inclusion of habitus in our models. … Future research must take account of the other components of Bourdieu's framework—habitus and field - to test more accurately the presence and effect of cultural capital for different groups (p. 62).

Diane Reay (see e.g. 2004) acknowledges the need to take into account more than the concept cultural capital. Drawing on ethnographic data gathered through participant observation, Reay (1995) uses habitus as an analytical tool for analysing peer group interaction in two different urban primary schools. She claims that habitus "as a method has the potential to reveal taken-for-granted inequalities embedded in everyday practices" (p. 353). Using a number of examples, Reay shows that the social game is embodied in these primary classrooms: "It could be seen both in the eager activity of working-class girls helping out … and in the barely expressed disdain of white, middle-class children". The habitus the students received from their home, and the cultural capital it provided gave some children power to position their teachers in inferi-

ority or put them 'in their place'. Reay concludes that habitus has the potential for demonstrating ways in which students create and recreate structures through their everyday activities. In addition, it has potential to reveal taken-for-granted inequalities of gender, race and class and that they are embedded in social processes.

The two last research examples (Dumais, 2002 and Reay, 1995) show how intertwined both the different factors and concepts are. Lundqvist (2010) has taken this into account in her thesis, analysing how young students in upper secondary school in Sweden formulate and imagine their future career choices in the transition from school to work. Building upon the concept of field, one of her results showed that "careership is by no means an individual process. Young people participate in a social game with other players on the field" (p. 307). Lundqvist suggests that when students think about their own position and evaluate their own resources, they are influenced by both social class and ethnicity such as social categorisations and positions. In addition, Lundqvist argues that the variation of what the young people interpret as their possibilities should be seen in relation to different social contexts; individual choices must be seen in relation to what the students see as relevant in different social fields. Considering how different fields influence the students' choices, Lundqvist states that how the students interpret the rules of the game are built upon, for example, their parents' experiences. According to Lundqvist it is through the students' habitus that students make choices that are already familiar and known. Similar results are reported by Dumais (2002) who found out when dealing with a student's thoughts about their future and their possibilities, different social fields must be taken into account as well as how they perceive themselves in relation to class, gender, and ethnicity. Recognising choices is therefore not an individual process, but rather something that is both influenced by historical, temporal conditions and dispositions, and how the students play the game in different social fields.

Zevenbergen (2005) initially hypothesized in her study on ability grouping in mathematics in secondary schooling in Australia, that

variables such as gender, year-level, and school would be important factors in student's interpretations. Using the concepts of habitus and field when analysing the experiences expressed in semi-structured interviews, she found that these variables were not as powerful as the practice of ability grouping. When the practice of ability grouping was implemented in mathematics classrooms this created a learning environment that became internalized as a mathematical habitus. If the student experienced the practice as positive there was a greater potential for the student to identify with the subject. When negative, there was a reduced chance of developing a habitus that helped the students. Zevenbergen states that the students' experiences were developed and arose in a social medium that could be seen as a field. Zevenbergen claims in turn that this field was ruled by particular practices and "the practices within the field contribute to what can be seen as legitimate and valued knowledge" (p. 611). Zevenbergen concludes that the practices, in this case the ability-grouping, constructed a habitus that included or excluded students from mathematics. She states surprisingly that the "outcome of these interviews was the overwhelming emphasis on the experiences of the ability grouping and the impact that these experiences had on the students' relationship with school mathematics" (p. 608).

Bourdieu's theoretical framework in science education

There are few studies in science education research that have consistently used Bourdieu's concept throughout the entire process. For example Goyette and Mullen (2006) use concepts from Bourdieu in their theoretical framework and when explaining results, but not throughout the analytical process. Goyette and Mullen studied which students chose to study art and science (A&S) as majors in the United States, using socioeconomic standards as measurements. They draw the conclusion that students from low-SES were more likely to choose vocational majors while students from high SES more frequently chose A&S. The A&S students

accumulate cultural capital in the form of familiarity with high culture, sophisticated use of verbal and written language, and confidence in their broad knowledge of history, culture, and politics…. this cultural capital, along with the status value of a degree from a selective college or university, provides a concrete resource enabling A&S students not only to enrol in graduate school and obtain prestigious careers but also to comfortably navigate particular social situations, participate in exclusive social networks, and feel empowered to confront social issues and problems in daily life (p. 525-526).

Like Goyette and Mullen, Clark, Case, Davies, Sheridan and Toerien (2011) used Bourdieu when explaining results regarding reproduction of inequalities in the science classroom. They studied teachers' professional development and a new topic in the curriculum, chemical systems, in South Africa. Similar to other researchers, they pointed to the workings of the values, discursive practice and interaction in middle-class families and the importance of cultural capital in school for academic success. The working class children, they claimed, "start off with an inherent handicap that persists throughout schooling" (p. 282) since they did not depart from the same level. According to Clark et al, the different starting points can be described as "unlevel playing grounds" which, they argue, could be connected to the concept of field. They emphasise the need to be aware that different forms of capital entailed success in different fields, concluding that "the pervasive power of cultural capital therefore rings a particular warning bell for any forms of curriculum development that needs to draw heavily on the knowledge that children may or may not bring with them from home" (p. 282). In addition, Clark et al pointed out that the exactly same thing could be said about teachers.

Bencze and Carter (2011) used Bourdieu to understand inquiry-based learning and the ability to discover abstraction through this learning approach. Bencze and Carter suggested that possibilities of discovering such abstractions in the science classroom were not equally distributed among the students. They claimed that this possibility appears to depend on "students' existing conceptual frameworks, knowledge and abilities to work in the abstract, etcet-

era; that is, forms of *cultural capital*' (p. 652, authors italics). In fact there were only a few students that easily discovered abstraction from inquiries and they came from advantaged homes. Linking to Lemke (1990), Bencze and Carter stated that this possibility was enacted by discourse practices that could be found in middle and upper class, north European American discourses. They concluded that

> advantaged children continue to function well within school science systems. Education (read science education) that sorts students according to their existing cultural capital, rather than attempting to promote real equity, seems *undemocratic*. Such education may contribute to well-documented increasing worldwide differences between rich and poor (p. 652, authors italic).

Wickman and Persson (2008) discussed Bourdieu in a science education perspective and the concept of cultural capital as a way to understand students' backgrounds and their possibilities of understanding the rules of the game and different discourses in the school science classroom. According to them, this had several implications in the classroom; the capital cultural that some students brought into the classroom was not valued in the lesson. The encounter between the students' cultural capital and school teaching was decisive when looking at how the content was being interpreted and understood by students and teachers. In addition, and like Clark et al, Wickman and Persson claimed that the teacher needs to be recognised. Just like their students, teachers have different backgrounds and therefore different possibilities of understanding and talking to students with different cultural capital.

Building upon data and results from PISA studies, Marks, Cresswell and Ainley (2006) and Turmo (2004) used notions from Bourdieu to explain and elaborate on the results and analysis from the PISA Survey. While Marks et al were more critical in how to interpret and understand and draw the correlation between school success and cultural capital, Turmo argued that the lack of cultural capital created a distance between student and the school culture. He claimed that cultural capital played a large role in the results

for science subjects and that the analysis suggested that "the relationship between the home's economic capital and students' level of scientific literacy is relatively weak in all the Nordic countries" p. 287). According to Turmo, there was a surprisingly strong relationship between the cultural capital of the home and the level of scientific literacy in several of the Nordic countries. I argue, however, that it is hard to do far-reaching and deep analyses of the variables and measurements that we find in PISA, since they are not connected to the specific field where the students could be found. Nevertheless, they can give us hints and valuable examples.

Bourdieu's concepts are powerful tools, although few researchers have studied habitus and field in concrete school science situations or used Bourdieu in the analytical process. They have not set the concepts in motion. However, some examples can be found. In a recent study, Engström (2011) has through a questionnaire studied 268 upper secondary physics teachers in Sweden. With the aim of finding out why physics teachers teach as they do, Engström used the concepts of capital and habitus to try to understand different teaching strategies and why these strategies were used. In her study, she assumed that school physics could be seen as a social practice and that the teaching practice was related to the teachers' lifestyle and how this lifestyle had been shaped. In addition, Engström assumed that habitus could be viewed both individually and collectively. According to Engström this gave her the possibility to reconstruct a collective teacher habitus based on "their positions as physics teachers in secondary school, their dispositions (capital) and their standpoints on content and methods in teaching, which are related to symbolic capital in larger fields (science, political, science education)" (p. 122).

In the analysis, Engström searched for groups of teachers and a cluster analysis resulted in three different types of physics teachers; 'the Manager of Tradition', 'the Challenger for Technology', and 'the Challenger for Citizenship'. These three types used different teaching strategies; they had different views on science and they also chose different content. The results from Engström's analysis

showed that the different teacher types, their background and life-style played a role in their choices and strategies in the classroom. Engström argued that "by making the habitus of the teachers in the different groups visible, it is possible to explain why teachers teach as they do and thereby make a contribution to both science education research and to teacher training" (p. 124). This study showed how teachers contributed to a reproduction of certain values and doxa in the classroom. Engström pointed to the fact that the physics teachers' middle-class positions in secondary school and their educational trajectories were important bases in their habitus. Engström concludes that teachers should reflect on their "backpack", and how their earlier experiences in life influence, for example, their strategies. However, I would suggest that when reconstructing habitus and constructing their identities on paper, Engström separates the teachers from their particular fields. If physics education is considered to be a field this might be possible. If not, it could be difficult to claim the relation between the particular classroom activities, and the teacher.

To conclude; little research has been done using Bourdieu's theoretical framework in science education research, while many studies have used Bourdieu as "intellectual hairspray". This thesis is therefore a contribution to this particular field of research using Bourdieu both as a theoretical and analytical framework. Nevertheless, earlier research has given inspiration for how to operationalize the concepts. In addition, earlier research has indicated that Bourdieu's concepts are difficult to use throughout the process. Nevertheless, earlier research also calls for research processes that intertwine cultural capital with habitus and field in order to make coherent conclusions.

Considerations when working with Bourdieu
I have raised critical comment against using Bourdieu's concepts as intellectual hairspray. Another common criticism of Bourdieu's theory is his deterministic interpretation (see for example Mills, 2008b). According to Harker and May (1993) Bourdieu has been

criticized especially by Giroux[1] "for an over deterministic account of the processes of social and cultural reproduction" (p. 170). According to Harker and May, Giroux states that the theory of reproduction demonstrates no hope for subordinate groups. Reay (1995) has also discussed these issues, concluding that "Bourdieu, himself, stresses that habitus does not determine outcome. Rather there is a dialectic interaction between a habitus and a field" (p. 353).

Other researchers have developed the concept of habitus and started to take an interest in the transformative and changing potential in the concepts, elaborating on, for example, *transformative habitus* (Mills, 2008b). Through semi structured interviews with teachers, parents and students in Australia, Mills explores the tensions between how marginalised students see themselves and how they are seen by their peers, teachers and fellow community members using habitus as a theoretical analytical tool. She argues that the ways the students see themselves fall largely into two categories: those with a reproductive habitus (who recognise the constraint of social conditions and conditionings and tend to read the future that fits them) and those with a transformative habitus (who recognise the capacity for improvisation and tend to generate opportunities for action in the social field). From this research, Mills draws the conclusion that teachers "should be more concerned to transform schooling; to provide educational opportunities that transform the life experiences of and open up opportunities for all young people, especially those disadvantaged by poverty and marginalized by difference" (p. 99).

Of importance in the research process is the awareness of whose capital that is ascribed value. Otherwise, there could be a risk that the researcher does not contribute to an understanding of the valuing and legitimising processes of the cultural capital itself, that often very naturally are transmitted, above all in elite families (Mehan, 2008). Regarding education Giroux (1980) has elaborated on

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[1] See for example Giroux, 1983a, 1983b

a similar thought, stating that "instead of providing compensatory education to the students with different cultural capital, the school, while appearing neutral, asks them to think and perform in a way that is quite alien to their own background" (p. 344-345). Which knowledge is ascribed as valuable in school science has been studied by Seiler (2001) working in a South African context. Her research asks questions regarding whose cultural capital that is valued in school, the implications this has for students with other forms of cultural capital and the devaluation of their own backgrounds and cultural capital. According to Mehan (2008), since schools "contribute to the reproduction of inequality by organizing schooling so it rewards the cultural capital of the elite classes and systematically devalues that of the lower classes" (p. 56) there is a call for awareness of the effects when addressing students' cultural capital. As a researcher I must, like Seiler and Giroux, ask myself during the research process whose cultural capital that is valued or not and be aware of what is legitimised through my own research. I suspect it will be a challenge to avoid a simplistic understanding of the notions and a challenge to show the complexity and different ways and structures that hinder or promote room to manoeuvre in certain fields.

Finally, I want to bring forward a criticism of the way the concepts of cultural capital and habitus have been used and which has grown clear to me when reviewing earlier research. Many researchers have not used Bourdieu's concepts throughout the research process; the concepts have been used when framing the research and/or in concluding remarks. It seems to me that there are problems working with and operationalizing Bourdieu's concept, especially with regard to micro levels such as classrooms. One of the researchers that has brought this forward is Mehan (2008), who claims that the theory provided by Bourdieu does not reveal how processes occur in concrete social situations. Mehan asserts that it is not shown how the school undervalues the cultural capital of the lower classes; neither is it shown how the cultural capital of the

upper classes is valued. Building upon earlier research[1], Bennett and Maton (2010) state likewise, that Bourdieu's concepts are useful tools for analysing the nature of a context. However they are not useful tools in analysing the actual nature of the knowledge and the practices that actors engage with in those contexts.

Bernstein (1975), another influential sociologist, working with reproduction in education, emphasises that theories which are helpful when doing analyses on a macro level can be weak in analyses of processes on a micro level. One example that has been observed by Cicourel, in a personal communication to Diane Reay (1995):

> Habitus seems in one sense, to be everything, yet hard to pin down observationally. Of all the different writers I have seen who use this notion of 'habitus', including Bourdieu, no one seems to care about this observational problem. Instead, everyone seems to posit a kind of plausible sounding 'force' that's attributable to 'habitus' and then refer to indirect data to document its existence and impact on everyday life. (Cicourel, 20/7/94, personal communication) (p. 357).

Cicourel identifies the same problem as Mehan did, when using Bourdieu, that there are problems in making observations. Reay (1995) fears that due to this, habitus becomes whatever the data reveals. Mutch (2003) comments in a similar way when dealing with the analysis of the data:

> Bourdieu's use of habitus has to be seen in the context of his broader project … This leads to analyses at a broad level of generalization, but problems occur when one seeks to apply the ideas at a more detailed level of analysis (p. 390).

Several researchers have noted similar problems when applying and operationalizing the theory provided by Bourdieu on a micro level. What other theories can be adopted or added when operationalizing the relation between social class and science class on the micro level in the classroom?

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[1] For example Maton (2003, 2005) and Moore (2007).

3.5 Alternative frameworks

Bernstein as a theoretical and analytical framework

Bernstein belongs to a group of researchers that, like Bourdieu, has studied and described the school system as a field for reproduction. Basil Bernstein has a background as a linguist and as such much of his works focus on language. Nevertheless, his theories have been used in many educational areas, in mathematics as well as in science. Where Bourdieu has studied many fields, Bernstein had his main interest in education and school (Sadovnik, 1991), often from a sociolinguistic perspective. As such, Bernstein theories are extensive when examining how school practices reproduce social advantage and disadvantage (Lerman and Zevenbergen (2004). However Bernstein was not only interested in how advantage and disadvantage are reproduced; fundamental in his theory is the consequence of this for different groups (Sadovnik, 1991; Hallstedt and Högström, 2005).

According to Sadovnik (1991), Bernstein "attempts to connect macro level issues of class and power relations to the micro level and its educational processes of the school" (p. 48). The classroom could be seen as a micro level that therefore could be examined using Bernstein's concepts. Zevenbergen (2001a), discussing work with Bernstein's concepts in mathematic educational research, gives one example that clarifies how this can be done. Zevenbergen argues that Bernstein's theoretical framework gives possibilities to "discuss the differences between the forms of language used by different social classes and their links with the language used in the school context" (p. 42). In this way, she connects social classes on the macro level with school context on a micro level. Zevenbergen claims that the student's family has shaped the student's language which entails that some students enter the school with familiarity with the language that is spoken in the mathematics classroom. Similarly, Sadovnik (1991) states that there are differences in what becomes visible and invisible in the pedagogic practice in the classroom, depending on social class background. The outcome can be that children from a certain background understand, interpret and

value the classroom and its pedagogy in ways that make them more successful. Thus, Bernstein can (as a complement to Bourdieu) provide theoretical and analytical tools on a micro level, such as a classroom, with similar aims that are fundamental in this thesis. To be able to operationalize the problems addressed in this thesis, some of the central concepts in Bernstein's theoretical framework will be elaborated on in following sections.

Code

The key concept that functions as a backdrop in Bernstein's theory is the concept *code*. The code can take different forms, however, working as a regulative principle that underlies a message system (Bernstein, 1975). This message system consists of curriculum, pedagogy and evaluation. The structures and processes of school knowledge, the transmission of school knowledge and its practices are constituted by this three message system (Sadovnik, 1991). The curriculum, the pedagogy and the evaluation are therefore crucial when understanding and researching the classroom, its structures, it processes and practices. Even though definitions have changed and may be interpreted differently, Bernstein (1975) noted in one of his early articles that "curriculum defines what counts as valid knowledge, pedagogy defines what counts as valid transmission of knowledge, and evaluation defines what counts as a valid realization of the knowledge on the part of the taught" (p. 85). What counts as formal educational knowledge is therefore realised through curriculum, pedagogy and evaluation - built upon and permeated, however, by the code (Bernstein, 1975).

To clarify: different ways of communication are used in school, realised in the classroom through curriculum, pedagogy and evaluation that is regulated by the code. However, different groups, classes or positions in society use different ways of communication. This entails that some groups, social classes or students do not use ways of communication that are valued or effective in school. The consequence could be that some may not understand the underlying regulative principle, the code, which needs to be followed. Some students become excluded (Bernstein, 2000). The concept of

code could therefore be a helpful tool when understanding the relationship between different learners, their outcomes, and the classroom with its curriculum, pedagogy and evaluation.

Classification and framing

If the code is realised through curriculum, pedagogy and evaluation, it is visible through what Bernstein (1975) denotes as classification and framing. Bernstein writes that "the code is fully given *at the most general level* by the relationship between classification and framing" (p. 90, authors italic). The concepts "will be used to analyse the underlying structure of the three message systems, curriculum, pedagogy and evaluation, which are realizations of the educational knowledge code" (p. 88). In other words, the code is made explicit through classification and framing, and the concepts classification and framing could be used to characterize the code.

Bernstein (1975) defines *classification* and *framing* as follows:

> Classification, here, does not refer to what is classified, but the relationships between contents. Where classification is strong, contents are well insulated from each other by strong boundaries. Where classification is weak, there is reduced insulation between contents, for the boundaries between contents are weak or blurred. ... Frame refers to the form of the context in which knowledge is transmitted and received. Frame refers to the specific pedagogical relationship of teacher and taught. In the same way as classification does not refer to contents, so frame does not refer to content of the pedagogy. Frame refers to the strength of the boundary between what may be transmitted and what may not be transmitted, in the pedagogical relationship. Where framing is strong, there is a sharp boundary, where framing is weak, a blurred boundary, between what may and may not be transmitted (p. 20, authors italic).

What Bernstein suggests is that there are relationships between boundaries - relationships that can be weak or strong. The concepts therefore refer to relations of power and control between, for example, subjects, discourses, categories, agents, groups or lessons (see e.g. Alm, 2010; Morais, 2002) and if the relations are weak or strong.

Classification has been used by Chien and Wallace (2004) to analyse power relationships. Chien and Wallace argue that within a school context this can be understood in power relations between teacher and students or between students. Some students receive greater degrees of power than others as a result of the hierarchy or the social standing in the group or through the way the teacher favours them. According to Chien and Wallace, classification can also be understood through the timetable and the arrangement of subjects and their hierarchy in the timetabling. It can also be understood in the arrangement and use of spaces and rooms in the school. Morias, Neves and Pires (2004) use the concept when elaborating on content in the classroom. For example, classification can be considered weak when knowledge from other disciplines and non-academic knowledge blur the subject in focus or when subjects are mixed.

According to Arnot and Reay, Bernstein (2000) developed the concept of frame to focus on the relationships between the teacher and the student and their role in "creating the pedagogic arena, game or specific practice" (p. 180). Bernstein (2000) writes that

> Framing refers to the nature of the control over:
> · the selection of the communication
> · its sequencing (what comes first, what comes second)
> · its pacing (the rate of expected acquisition) the criteria; and
> · the control over the social base which make this transmission possible
>
> When framing is strong, the transmitter has explicit control over selection, sequence, pacing, criteria and the social base. Where framing is weak, the acquirer has more apparent control (I want to stress apparent) over the communication and its social base (p. 12-13).

For example, for the teacher, strong framing entails reduced possibilities; weak framing entails increased possibilities and options (Bernstein, 1977). Morias (2002) gives another example of strong framing in an assessment situation. When the teacher makes the evaluation criteria explicit by assigning a value to each question in

the test, the assessment situation could be said to be strongly framed. Morias argues together with Miranda (1996) that strong framing, i.e. explicit criteria, makes it easier for the student to produce what is legitimized by the school. Morais and Miranda claim that when criteria are made explicit some students more easily understand what the teacher and the school asks for. The other way around, implicit criteria might instead give certain groups of students disadvantage. Another example of a strongly-framed situation in the classroom is the triadic dialogue (Lemke, 1990, see chapter 3.3.). When using a triadic dialogue, the teacher controls the selection of communication, the sequencing, and the pacing. The consequences might be that students respond differently to this strongly-framed communication pattern. Some students could gain from this way of talking, while others struggle with the interpretation and fails to be a part of the classroom dialogue.

Thus, the effects of the code influence groups of students differently and have consequences on the classroom. These lead Arnot and Reay (2004) to state that fundamental for the concept of framing is that it brings forward many of the core arguments regarding reproduction of social inequality.

Regulative and instructional discourse

Bernstein has developed some of his definitions throughout his career. Concepts such as regulative and instructional discourses are examples of this[1]. Arnot and Reay (2004) put forward that framing is developed into two rules, or rather discourses, where "*regulative discourse* … including expectations about conduct, character and manner, and the rules of the discursive order and *instructional discourse* referring to the selection, sequence, pacing and criteria of knowledge" (p. 138). Regulative discourse refers to the transmission of rules of the social order and forms of human relations, such as ways of talking or raising hands. The regulative discourse deals with conduct, character and manner. Instructional discourse in the

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[1] See Bernstein (2000, p. 120) regarding the development over the last 30 years and in particular the concepts regulative and instructional discourse in relation to the concepts expressive and instrumental order.

classroom refers to transmissions of specific skills and their relation to each other, such as being able to calculate or to see the difference between two chemical substances. Instructional discourse deals with the selection of content, how it is sequenced, its pacing and the criteria of knowledge (Bernstein, 2000; Arnot and Reay, 2004). Daniels (2006) argues that the characteristics and the features of an instructional discourse are relatively clear. The regulative discourse, however, is more diffuse and can be transmitted in many ways through different forms. He claims for example that the regulative discourse can be communicated by "the school's (or any institution's) public moral practice, values, beliefs and attitudes, principles of conduct, character and manner" (p. 46). Similarly, Morais (2002) states that the regulative discourse is not always explicated; nonetheless, this does not mean it is not there.

Both discourses can be weakly or strongly framed according to Morais and Miranda (1996). A teacher can mostly explicitly transmit, with clear frames, what kind of values that the pedagogy is built upon, indicating a strongly-framed pedagogy. An instructional discourse can be weakly framed when for example, criteria of the selected content are implicit, lacking components such as assessment matrix or outspoken expectations. However, fundamental to Bernstein is that regulative discourse always dominates the instructional discourse (Bernstein, 2000). He claims:

> In one sense, this is obvious because it is the *moral* discourse that creates the criteria which give rise to character, manner, conduct, posture, etc. In school it tells the children what to do, where they can go, and so on. It is clear that regulative discourse creates the rules of the social order. However, I also want to argue that regulative discourse produces *the order in the instructional discourse.* There is no instructional discourse which is not regulated by the regulative discourse (p. 34, authors italics).

Earlier texts[1] from Bernstein give clues about how the instructional and regulative discourse could be connected to the students' back-

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[1]This regards foremost the texts about the concepts expressive och instrumental order (Bernstein, 1975).

ground and family. The family can accept the way the instructional discourse is constructed in the school and support their student in the discourse. Similarly, the family can support the students to accept the regulative discourse. Parents can act in the opposite way, not accepting and not supporting the students when, for example, not accepting the examination structure, or the linkage between education and occupation (Bernstein, 1975). A family could also accept the instructional discourse and the way knowledge is transmitted, but not have the means to support their child. Instead, what to do in school, with its code, becomes hard to realise, Bernstein writes

> The family wants the child to pass examinations, to get a good job, and also conform to a standard of conduct often different from the one the family possess. This is often aspiring working-class family. For such family, the procedures of the school are often a closed book (p. 41).

Bernstein's ideas of the two discourses have resonance with the findings of Lemke (1990). Lemke states that there are two things going on in the science dialogue:

> First, people are interacting with one another, move by move, strategically playing within some particular set of expectations about what can happen next (the activity structure). But they are also constructing complex meanings about a particular topic by combining words and other symbols (p. 13).

I argue that there are similarities between the activity structure and the regulative discourse and between constructing complex meanings and the instructional discourse. The difference is that Lemke refers to a specific school science context, Bernstein to a more general educational context. In this thesis, connecting these thoughts and applying them to the specific science classroom can be an advantage.

To conclude; the code is realised through curriculum, pedagogy and evaluation. This three message system could be characterized through the concepts of classification and framing which in turn

could be elaborated on using the concepts of regulative and instructional discourse. The student, on the other hand, can be described using other concepts, for example access to recognition and realisation rules.

Recognition and realisation rules

According to Bernstein (2000), to be able to produce what the school asks for, recognition and realisation of the rules are needed. In discussing the two concepts, Bernstein states that "recognition rules essentially, enables appropriate realisations to be put together. The realisation rule determines how we put meanings together and how we make them public. The realisation rule is necessary to produce the legitimate text" (p. 17). When discussing these two basic rules, Morias and Miranda (1996) argue that the students need recognition rules to be able to distinguish what is specific in a given context. To be able to respond and produce what is asked for (hidden or not) you need realisation rules.

As stated earlier, Bernstein was genuinely interested in consequences for the learner. Correlating this to recognition and realisation rules, Bernstein (2000) notes that

> Many children of the marginal classes may indeed have a recognition rule, that is, they can recognize the power relations in which they are involved, and their position in them, but they may not possess the realisation rule. If they do not possess the *realisation* rule, they cannot then speak the expected legitimate text. These children in school, then, will not have acquired the legitimate pedagogic code, but they will have acquired their place in the classificatory system. For these children, the experience of school is essentially an experience of the classificatory system and their place in it (p. 17, authors italic).

Regulation and realisation rules therefore concern class differentiation and its consequences in classroom. I therefore argue that the concepts of recognition and realisation rules can contribute in an operationalization of social class in the school science classroom.

To conclude: how the code is interpreted and understood by the student could be explained with realisation and recognition rules and depends on e.g. regulative and instructional discourses in the classroom. Using the concepts derived from Bernstein it is therefore possible to study students' educational differences and the activities and practices in the school science classroom.

Vertical and horizontal discourse

The concepts of vertical and horizontal discourse were developed by Bernstein (2000) as a way to analyse forms of pedagogic discourses. From Bernstein's perspective, these concepts are an attempt to produce a language that describes and explores e.g. "the social basis of this differentiation" (p. 156). This could be done through *vertical discourse* that "takes the form of coherent, explicit and systematically principled structures, hierarchically organised as in the sciences" (p 157). In contrast to vertical knowledge stands *horizontal discourse,* which entails "a set of strategies which are local segmentally organised, context specific and dependent, for maximizing encounter with persons and habitats" (p. 157). In education, vertical discourse is often referred to as school(ed) knowledge and the horizontal as everyday, common sense knowledge, or local knowledge.

Bernstein (2000) claims that "as part of the move to make specialised knowledge more accessible to the young, segments of *Horizontal discourses* are decontextualized and inserted in the contents of school subjects" (p. 169, authors italics). This entails that students who often encounter horizontal forms of discourse (in attempts to make specialised knowledge more accessible to the young) in the end lack the vertical discourse that had given them accessibility. Nylund and Rosvall (2011) state that horizontal discourse - everyday knowledge - has limited potential in changing circumstances and conditions outside the context where it has been taught and formulated. Vertical forms of knowledge can give power and have the potential to question existing circumstances, since it gives possibilities and access to think outside the context, outside the box. Forms of knowledge could therefore be linked to what kind of pos-

sibilities and limitations students have and describe how school differentiates students.

In the same way as Bourdieu's concept, I claim that Bernstein's concept must be brought to life in order to be understandable and to give clues about the ways to use them. Otherwise they tend to end up as slippery, non-adhesive, "Teflon" concept. The following sections therefore aim to provide some further information and knowledge that could be helpful in the further research process and how to operationalize the issues addressed in this thesis.

Bernstein's theoretical framework in educational research

Arnot and Reay (2004) worked with the concept of framing when reporting on their study involving two secondary schools. The first school had students from working class and multiethnic contexts and a teacher working with a weakly framed regulative discourse. The second school had a tradition with strongly framed instructional discourse. In the first school Arnot and Reay found that higher achieving girls "seemed to be operating with weaker framing than other groups in the class" (p. 140) and some of the working class boys reported that they were able to influence the teacher to change the pace so that it fitted their needs. This showed that the control over the pedagogical practices was shaped by the social relations of the classroom. Arnot and Reay argue that "some middle-class, higher achieving pupils appeared able to experience a certain degree of autonomy" (p. 142). They state that in the first school, time, pacing and speed in the pedagogical practices played an important role in reinforcing social inequalities. In the other school, the students appeared to adjust their pace of learning to the expected learning pace. More often they tried to keep up with the strongly framed pace of teaching rather than trying to control it themselves. Arnot and Reay found that in the other school "control of the pace of learning was minimal for those pupils having most difficulty with it" (p. 142). While in the first school

> working-class boys appeared to have the least control over the pace of the learning. … Their anger about the pacing of learning was clearly in evidence. … Strongly framed pacing defined

the nature of pedagogic communication and enhanced the relationship of pupil non-cooperation and opposition with teachers. Working-class boys lacked the resources to make teachers listen or to control their own learning (p.143).

Arnot and Reay states that in both schools, despite the differences in the school, students "especially those from disadvantage or 'marginalized' classes … did not appear to possess the recognition or the realisation rules that were expected to be a common form of pedagogic communication between teacher and taught" (p. 148). Craig, one of the students in the study, commented on the gap between home and school:

> Like your parents give you like different methods of learning and then when you come into school, they say something different and you get confused and then you mix it like together and then you get it like wrong because you get confused (p. 146).

Arnot and Reay suggest that middle-class children more often employed the possibilities of pedagogic practice. They conclude that school cannot provide everything that the students need to understand and that "middle-class homes tend to provide an effective second site of acquisition with effective official pedagogic context and support (p. 149).

In a Swedish context Cederberg (2006) described and analysed a group of foreign female students' perspectives on their first meeting with the Swedish school, and their subsequent school careers. Cederberg claims that the Swedish school has deeply entrenched expectations of different activities and how they are to be conducted. There are norms that do not need to be clarified or explained. This is in conflict with weakly framed activities that have a more or less hidden demand for student activity. This contrasted strongly with the women's earlier experiences, where their own initiatives not were rewarded. Cederberg suggests that the school as an institution, with different working methods and relationships than the women had been used to, obstructed the women's school careers. In order to deal with this situation, the women developed different strategies, observing others and sometimes changing their behav-

iour. When they met a weak classification and weak framing which they were forced to interpret, they eventually understood that they were expected to be active. They had to express their opinions in discussions during the lessons as well as actively seek knowledge. One strategy that the women used was to observe other students' behaviour in the classroom and tried to adjust accordingly. Their earlier experiences of classroom work, demands and expectations were not discussed in school and they were not helped to decode the pedagogy they were confronted with in Sweden. Cederberg concludes that "the present study shows that even ethnic background, connected to experiences and expectations of the classroom framing is significant" (p. 220). I suspect that a similar analysis could be applied to a social class perspective.

Nylund and Rosvall analysed the uneven distribution of knowledge and power in the Swedish upper secondary school system using the concepts of vertical discourse and horizontal discourse (Bernstein, 2000). Nylund and Rosvall claims that there was a strong link between forms of knowledge and who the student becomes as different forms of knowledge creates possibilities or limitations for action. Since some students' interaction with everyday knowledge only took place in school (which does not allow the further possibilities that vertical discourse gives) they were trapped inside their context. They remained without access to the vertical discourses that would have given them the opportunity to break the uneven distribution of knowledge and power in the education system and in society.

Bernstein's theoretical framework in science education

Morias has (with or without colleagues, e.g. 1996, 2002, 2004, 2005) reported from a larger research project which aims mainly to carry out sociological studies on classrooms and to find pedagogic practices that can contribute to achievement for students from disadvantaged social groups (see e.g. Morais and Miranda, 1996). Based on previous studies Morias and Miranda (1996) aimed to understand to what extent students understand evaluation criteria and the marking criteria and procedures used by teachers, i.e. the

extent to which the student has recognition and realization rules. They were also interested in how this understanding and the possession of recognition and realisations rules were related to social class and the social context of the school. Thirty-three students from two different schools were followed through a test situation and were interviewed. Information regarding students' social class was obtained through questionnaires answered by their parents in an interview. Morais and Miranda discovered that there was "a clear relation between students' acquisition of recognition and realization rules and social class … the higher the social class, the higher that acquisition" (p. 601). Morais and Miranda claim that there was a relation between recognition and realization rules and achievement where poorer achievers did not acquire necessary recognition and realization rules. They also draw the conclusion that the level of students' scientific knowledge was related to how the teacher's evaluation criteria was expressed and that "especially those disadvantaged in terms of social class and social context, do not understand teachers' evaluation criteria. This will make their access to the text legitimized by the school difficult" (p. 622).

In a study from 2005, Neves and Morias investigated how family factors can explain the general failures of socially disadvantaged students regarding school science achievement. An important aim of the study was to construct a model which could analyse the pedagogic codes in different families. The study involved five students and provided ideas on how to work with these specific issues rather than broader generalizations. Neves and Morias found out that there appears to exist a correlation between the families' general coding orientation and social class. They suggest that the specific practices in the family could explain why children achieve differently at school. They state for example that "the access to middle-class cultural contexts constitute sociological factors that may explain departing situations related to the coding orientation we found in some members of the working-class families" (p. 133). There were also differences in how the pedagogical discourse was included in the family discourse; it was more present in the middle class family discourse. Consequently, some student had gained rec-

ognition and realization rules needed in particular practices through their families which gave them better chances to succeed.

There are only few examples of using Bernstein's theory in science education research. However earlier research indicates that there could be advantages in using his framework. How could that be done? How well do the theoretical frameworks of Bourdieu and Bernstein correspond?

3.6 Combining Bourdieu and Bernstein

Earlier research (see chapter 2.5) calls for a closer look at the classroom and its practices when dealing with equitable opportunities to learn. For example Mehan (2008) suggests that "this involves more closely investigating just how modifying classroom discourse, untracking or detracking practices, and forming democratic schools actually forges more equitable opportunities to learn" (p. 61). Bennett and Maton (2010) suggest that Bourdieu's concepts are not useful for analysing the nature of knowledge and practices students engage with in contexts. Instead, they suggest that Bernstein provides a theory that concerns different forms of knowledge and takes into account informal everyday contexts and educational contexts. Bernstein (1996) himself argues that many theories on cultural reproduction are theories that are not "concerned with descriptions of the carrier, only with a diagnosis of its pathology" (p. 10) and "are incapable of generating specific descriptions of the agencies relevant to their concerns" (p. 9). Harker and May (1993) have a more nuanced argument stating that Bourdieu has been more successful in conjoining macro and micro levels and analyses. According to them, Bernstein has continued to work predominantly at analysing education at the micro level despite his aims to do the contrary. Even though Harker and May argue that Bourdieu has been more successful in combining analysis on the micro and macro levels, they do acknowledge Bernstein's work on a micro level.

Mutch (2003) claims that there are problems when working with the concept habitus, in particular "at more detailed levels of analysis" (p. 382). This led him to the theories provided by Bernstein. Mutch argues that Bernstein's work "offers ways in which we might connect the rather slippery and vague categories of high theory with the detailed investigation of concrete situations" (p. 394). One possible way forward in this research process could therefore be to use both Bourdieu and Bernstein.

Diane Reay (2010) states that when working with identity formation in educational research and theory context you have to engage in both micro and macro levels. She argues that "Bernstein can be utilized to examine micro aspects of identity. Similarly, Bourdieu's work can be deployed to explore macro dimensions of identity formation in schooling" (p. 291). The aim of this thesis does not primarily concern identity formation; however, the individual's dispositions and possibilities are important. Seen from this point of view, Reay's argument supports the idea of using Bernstein theories together with Bourdieu's. Mutch (2003) argues that the work of Bernstein and his collaborators supplements Bourdieu's work in several ways. According to him, Bernstein elaborates in much more detail on how unconsciously acquired dispositions and characteristics might be formed. In addition, Mutch brings forwards that Bernstein considers habitus as a more general concept than the code concept which emphasises that Bernstein could be used in more specific school context, in this case the classroom.

Collins (2000) discusses similarities and differences between Bernstein and Bourdieu. He argues that both of them are concerned with theories that contribute to our understanding of social and cultural reproduction. Moreover, they are both concerned about how "language is conceptualized as a complex symbolic means through which knowledge is transmitted and transmuted" (p. 66). But Collins underlines the fact that there are undeniable differences. "Bourdieu, for instance, has a more robust account of class relations in complex societies, while Bernstein has provided more penetrating, politically-informed accounts of pedagogy in and out

of schools" (p. 66). However these two differences may prove to be something I could take advantage of, since this research aims to understand the relation between class and the accounts of science education. Bernstein (1975) stated himself after he had been working in France close to Bourdieu's group, that their work was complementary. Bernstein states that "whereas they were concerned with the *structure* of reproduction and its *various* realizations, I was essentially concerned with the *process* of transmission" (p. 15, authors italics). Bourdieu (1991) in turn raises criticism of Bernstein's concept of code. He argues that Bernstein contributes to a canonization of the language of the dominant class when not considering the social conditions that surrounds the code. This is a risk worth taking into account, and can be compared with the earlier discussion about cultural capital that showed the need for reflexivity.

To conclude, I see possibilities of using Bernstein on a micro level when making detailed examinations and analysing the school science classroom, its processes and activities. I claim that there is an advantage that Bernstein as a sociolinguist has worked in many ways on language; something that earlier research has shown decisive in the science classroom and the school science field (see section 3.3). Bourdieu's concepts will be used when elaborating on the field analysing structures of reproduction and its various realisations, what is valued in the classroom (through cultural capital) and how students make use of cultural capital and habitus in the field. Moreover, Bourdieu's emphasis of linking the macro level to the micro level is fundamental for the research issues. In addition, what could be an advantage when implementing Bernstein in the research process is brought forward by Mutch (2003). Bourdieu had focus on the elite classes, where Bernstein in more detail focused on the middle-class. While this could be discussed, it nevertheless has relevance in a school context often seen as a middle class institution. I claim, in line with Harker and May (1993) that "hence the two theories, each with their own trajectory and agenda, could be seen as complementary where they intersect in the field of education" (p. 173).

Bourdieu can give the research process tools to understand the broader perspective of the picture and its relations to its context, while Bernstein facilitates a detailed description of the picture. Working alternately with Bourdieu and Bernstein can give the picture more depth and perspective, more colours and shadows, giving more multi-faceted descriptions and analysis. They could have two functions, and while sometimes blurred, their fundamental aims are similar. Collins (2000) states that they both emphasise the reproduction of social hierarchies. Their similarities have also been noted by Hanrahan (2006) who claims that sociologists and sociolinguists such as Bourdieu, Bernstein, Gee and Lemke do not accept

> explanation of failure being due purely to innate lack of talent and/or moral fibre on the part of science students. They provide convincing alternative explanations as to why many students do not succeed in academic studies, including science, explanations that have to do with the discourse of science education or the discourse of academic education more generally (p.9).

According to Hanrahan, both Bernstein and Bourdieu seek other explanations than talent in science education. They are driven by the very same aims and share in many aspects epistemological similarities. I claim that this will not hinder the further process nor invalidate possible conclusions.

3.7 Aims and research questions

The overall aim of this thesis is to contribute to a more complex and multi-faceted description and analysis of inequalities in education with the overarching aim to elucidate social class in the science classroom. However operationalization of these issues is not easy. Therefore, building upon earlier research and the theoretical frameworks, the research will be operationalized through (a) descriptions and analyses of what ways of acting and talking that are valued or not in the science classroom and (b) how these ways of talking and acting can be related to social class. The following figure describes how the aims are divided into operationalization levels:

Figure 3.1 Aims and operationalization levels

Social class in the science classroom
 	
This research will be operationalized through descriptions and analyses of what ways of acting and talking that are valued or not in the science classroom and how these valued ways of talking and acting in this science classroom can be related to social class. This is done through:
	An analysis of this specific classroom in relation to a science education field. Analytical tools:
	    Field (Bourdieu)
	    Doxa (Bourdieu)
	    Code (Bernstein)

	An analysis of how this specific science classroom is organized. Analytical tools:
	    Classification, strong/weak (Bernstein)
	    Framing, strong/weak (Bernstein)
	    Triadic dialogues (Lemke)
	    Regulative discourse (Bernstein)
	    Instructional discourse (Bernstein)
	    Vertical discourse (Bernstein)
	    Horizontal discourse (Bernstein)

	An analysis of what and who is valued and important in this specific science classroom. Analytical tools:
	    Habitus (Bourdieu)
	    Cultural capital (Bourdieu)
	    Recognition rules (Bernstein)
	    Realization rules (Bernstein)

Building upon earlier research and the operationalization levels following research questions are developed and will guide the further process:

1. How is this specific science classroom situated in the field of science education (through foremost the concepts field, doxa, and code)?
2. How is this specific science classroom organised (through foremost the concepts classification, framing, instructional and regulative discourses, vertical and horizontal discourses)?
3. What are valued and important in this specific science classroom (through foremost the concepts habitus, cultural capital, recognition and realization rules)?

4. METHOD AND METHODOLOGY

4.1 Introduction

This chapter focuses on descriptions of the gathering of data and the analytical process. In addition, the chapter aims to reflect over crucial steps and decisions that are made in these processes. Ehn and Löfgren (2010) argue that elaborating on and investigating tensions between, for example, culture and society or individual experiences and general structures is one of the most important research tasks. Through the theoretical and analytical tools, this research process takes into account these tensions. Therefore, this chapter also aims to elucidate the processes when working with the intertwined relationships between the micro level, e.g. the classroom with its students, activities and practices, and the macro level, e.g. society with its structures. Consequently, the data that I need to investigate the research questions could not be understood through data produced from a classroom only. It is placed in a certain context, a field. Seen from this view, what has been presented in earlier chapters regarding the science field is important as well. However, this chapter focuses on the production of the data in a classroom with an ethnographic approach.

4.2 Ethnographic approach

The research process undertaken has in many aspects been inspired by an ethnographic approach. However this needs to be discussed. For example, an ethnographic research process questions the aims

and the guidance from theoretical frameworks. An ethnographic process more often goes into a field with the aims of producing new knowledge and theories, rather than to build upon previously-existing theories. Ethnographic researchers more often, rather than collecting data, produce knowledge and "storied versions… [that] reveal, interpret and represent every day encounters, which ethnographers sometimes use in order to develop new education theory" (Beach, 2005, p. 1). Seen from this perspective, the research process that has been undertaken is not core ethnography from the beginning to the end. However, Wolcott (1990) claims that "without some idea of what you were up for, you could never had set out for your research site in the first place or known what to look at once there" (p. 60). According to Wolcott, what has been carried out in this particular research could be denoted as micro-ethnography "giving emphasis to particular behaviours in particular settings rather than attempting to portray a whole cultural system … [with] narrowed focus and manageable objectives" (p. 64).

Power (1998) who like me used Bernstein as a theoretical framework claimed that the kind of research she undertook had "some distance from the 'grounded theory' approach that is often seen as the distinctive feature of ethnography" (p. 13). Similar to me, she did not start out from tightly-framed hypotheses but had theories she wished to address. According to Power, this made it possible "to construct empirically grounded and theoretically informed connections" (p. 25). There was a risk that the research project that I have undertaken, in relation to ethnographic methods, could be seen as over theorized. One way to addresses this problem is discussed by Marcus (1998) who argues that ethnographic research projects "that are heavily motivated by and cast in culture theory terms must be allowed to 'breathe', especially in terms of their descriptive accounts of things, before the theory kicks in. … Otherwise, why bother with the arduous sweat of fieldwork?" (p. 18). Therefore when presenting my data I have tried to let my descriptions "breathe" in relation to the theories (see further discussion in chapter 4.6). In addition, bearing in mind my former role as a science teacher, the theoretical framework that guided the process

was important since it prevented me from different kinds of blindness and self-confirming research (Power, 1998). It has been structures that guided my research and helped me stay focused during fieldwork (Wolcott, 1990).

When going into the field, stating the fundamental aims of an ethnographic process has been important. It has helped me to focus on and study people and social phenomena in a natural context (Esaisson et al, 2003). School and classrooms are messy places and ethnography is, according to my interpretation, interested in these messy places and to record and present "the 'nitty-gritty' of everyday life, of how 'the meat is cut close to the bone' in ordinary cultural practices (Willis and Trondman, 2002, p. 398). Like Carlone (2002), I "wanted to understand both explicit and tacit cultural knowledge that guided the participants' actions and beliefs" (p. 312). I wanted to see both what could be seen and said but also what was implicitly brought forward. An ethnographic approach help me to set focus on the common, on what was considered normal, on the sometimes unintentional, hidden, and the taken for granted (Ehn and Löfgren, 2010). Producing this kind of data often implies that the researcher "participates, overtly or covertly, in people's daily lives for an extended period of time" (Hammersley and Atkins, 1983, p. 2). I did not attend this particular classroom for a long time; however, the time factor might not be crucial and has been discussed by for example Beach (2005) that claims that "in itself time is irrelevant. It is how the time is used in order to be familiar and trustworthy that is important" (p. 5). I argue that my former role as science teacher has been important in this case, since it has helped me not only to become familiar very quickly but also trustworthy in the relation to the students and the teachers (further discussed in 4.4).

Whatever label that could be applied to my research (Wolcott, 1990), ethnography as a method has inspired it, above all its methods of producing data. The ethnographic approach did not delimit what kind of data that was valid: glimpses, gestures, field notes, questionnaires - all these are things are data that helped me under-

stand the issues addressed (Power, 1998). One aim was also to do video recording when producing data (as one way to examine more deeply the events in the classroom). However, the students opposed that, and I conceded to their wishes. Instead the field notes with their pictures, drawings and the notes became even more important. Not least, the ethnographic process has also been a support when presenting the data. I have tried to present them "in ways that produces the maximum 'illuminations' for the readers" (Willis and Trondman, 2002, p. 39) and I have constantly borne in mind that "ethnography and theory should be conjoined to produce a concrete sense of the social as internally sprung and dialectically produced" (p. 39).

4.3 Producing data

The data was produced in the spring semester of 2010 at a compulsory school with most students having Swedish background. The school was situated in a small town with approximately 10 000 residents. The study was carried out in a year eight class with students aged fourteen and fifteen. The students were followed during a five week unit on physics (mechanics) and some additional lessons on technology[1]. Class 8D, consisted of twenty-one students. Eighteen of them agreed to participate in the research and were included. The remaining three students either declined to participate or did not fill in the consent form and were therefore excluded from this study.

The teacher was contacted in the autumn of 2009. During the first visit, it was decided to conduct the research in one of her classes. We decided that I could attend the class during the unit on motion and mechanics in the following semester. Contact with the principal was taken and I made an agreement with him to collect data in this particular school. When meeting the class the first time I introduced myself and the research. I asked for the students' and their

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[1]Technology in this school was taught by the science teacher, often seen as a part of science education. The timetable designated Science, meaning that the students had physics, biology, chemistry or technology. The different subjects were usually taught in units of 3-5 weeks.

parents' written permission (Appendix A, B). On this written consent form, each student and their parents were able to give me their approval to be a part of the research. The students agreed to be audio-recorded but not video-recorded. When starting the time in the class, an observation template and observation guide (Appendix C) were used. During the science lessons I recorded, collected student work, wrote field notes. In addition a questionnaire (Appendix D) was carried out. During other lessons I interviewed the students. Immediately after every lesson I recorded short reflections of my experiences, feelings or incidents in the classroom.

There are no clear answers regarding how to produce data (Denzin and Lincoln, 1994). Corresponding with my theoretical framework, the ethnographic approach directed what was needed to answer the research questions. I have seen the time in the classroom as a part of the research process, with an intense communication between the data and the theoretical frameworks where I produce "empirically grounded and theoretically informed connections" (Power, 1998, p. 25). One example of this is the analytical diary that I wrote during and immediately after the data gathering period. It was filled with excerpts and notes from the observations, reflections and comments from supervisors, colleagues and peer-reviews of conference papers. Into this I inserted theoretical assertions and questions - for example, signs of a certain cultural capital or what the teacher seemed to attribute value to. It could also be short episodes with brief analyses of what the student realised or recognised in this particular episode. In this way, the diary became an important first step when starting the analysis. Writing everything down (observation template, analytical diary, field notes and transcripts) does not only reflect the way I worked, it also became a useful help in reviewing the data and the analytical process. Moreover, the analytical diary and the careful bookkeeping made transparency possible.

The classroom and the school were in themselves - and belonged to - complex fields that were difficult to grasp and understand. Many things happened simultaneously, on diverse levels and in different

ways. For example, when the students were doing laboratory work in groups they wrote, arranged materials, communicated with friends and teacher, laughed, discussed, shouted. They looked at the whiteboards, at their instructions, someone went to the toilet, others used mobile phones, they teased each other and taught others. The classroom (as well as each and every student) communicated with and consisted of myriads of activities, words, events, feelings, expressions. Through the ethnographic methods it was possible to catch glimpses of this "nitty-gritty", messy everyday world while remaining focused on my aims. In addition, this increased the reliability of the data, studying the very same students or activity from different perspectives, giving me careful descriptions from altered angles (Denzin and Lincoln, 1994).

Table 4.1 Overview of produced data

Observations:	14 lessons including field notes
Recordings:	Interviews with 17 students, totally approx 6 hours; Interview with teacher, approx 43 mins; 37 recordings of groups during lesson, approx 21 hours; 14 short reflections, approx 59 mins
Written material:	<u>From students:</u> 8 laboratory reports; 33 written tests, prepared and unprepared; 17 pieces of students' own written assessment Mechanics; 13 pieces of students own questions to be used in a class competition (some worked in pairs); 14 reports from "Building a car"-project; 14 assessments from "Building a car"-project; 17 questionnaires <u>From the teacher:</u> Time table; Laboratory matrix (included for example information on what goals and knowledge objectives to reach on different levels when doing laboratory work); Assessment matrix (included for example information on what goals and knowledge objectives to reach on different levels in the unit Mechanics II); Local curriculum Mechanics II, "Mekanik ll, NO så 8, mål för denna skola"; 7 different hand outs: "Vad vet du om rörelse. Vad vet du om kraft", "Laboration faller alla föremål lika fort", "Lärares sammanfattning av Vad vet du om rörelse. Vad vet du om kraft", "Sex frågor om friktion etc", "Räkneuppgifter", "Upptäck en hävstångslag", "Teknik, bygg en bil"; Written test Mechanics II; Teachers planning for Mechanics II; New plan for rearrangement of students, photo of the class, student list; Autumn 2011: List of final grades list year 8; Spring 2012: List of school-leaving certificates, year 9 <u>Other:</u> Article from local Newspaper discussing the premises of the school and the general achievement level of the students in the school; Statistical reports from SCB and The Swedish National Agency of Education

Observations, field notes and recordings

Corresponding with the aim of this thesis to describe and analyse, I used observations as one way to produce data. The overall purpose with the observations was to observe "the characteristics of an individual unit – a child, a clique, a class, a school or a community" (Cohen and Manion, 1994, p. 106). The observations were foremost carried out in 8D's science classroom where the students usually were seated in eight groups of two or three at large desks. The observations were undertaken foremost from sitting at a chair in the back of the classroom. From that position I was able to follow what happened everywhere in the classroom. Through gathering of student work and recordings (often two or three per lesson), I could follow group discussion afterwards.

Patton (1990) argues that there is no universal description of how field notes should be taken. With inspiration from other researchers (Scherp and Scherp, 2010; Esaiasson, Gilljam, Oscarsson and Wängnerud, 2003) I choose to write field notes in an observation template (Appendix C). It helped me to remember where the students were seated, activities, and the different recordings. The field notes included content from the white board and what the teacher wrote and drew there. In addition, sketches of demonstrations that the teacher carried out and how the students performed their laboratory work were included. Moreover, the field notes helped me to see nonverbal communication such as raised hands or nods from the teacher. The observation template therefore became an important part of studying and structuring my data both during and after the data production. For example, before every lesson I looked back at the observational guide from previous lesson. There could be students that I unintentionally had missed (I am also part of the society and the hidden, taken for granted struggles and patterns) or if there were groups of students that for some reason needed extra focus or additional questions. On several occasions, I had to change my plans or take into account new perspectives for the forthcoming lessons.

I never felt that the students were disturbed by the recording devices, which were small mp3 players. Sometimes they used funny words or a joke, but usually they seemed to forget about the mp3 and as far as I can assess, acted normally. Nevertheless, the presence of the recording devices must be taken into account (Nilsson, 2009). I cannot state with absolute certainty whether or not their use altered the situations or the dialogues.

Student work and hand outs were added to the field notes and the recordings. For different reasons I have not been able to collect a complete set of all student work from all students. Sometimes I have asked them several times and reminded them, but in the end I decided that a good, smooth relationship with the students was more important and preferred not to nag them. The student work and hand outs were borrowed and copied from either the teacher or the students. Much of the student work includes teacher's comments and assessments.

Interviews

The interviews with the students were conducted during lessons other than the science lessons. They were individual interviews and they were audio recorded. The interviews took from ten minutes up to approximately thirty minutes to conduct. Some interviews were hard to get going and the students seemed impatient. Other students I almost had to stop. A semi-structured interview guide was developed (Appendix D) as discussed by for example Patton (1990). If the format was inspired by Patton, the content of the question was inspired of researchers such as Bourdieu (1990), Broady (1985), Mills (2008), Reay (1995, 2004), and Zevenbergen (2005). When asking questions related to science I have used inspiration from for example Hägerfelth (2004), Jakobsson (2001), and Mortimer and Scott (2003). Therefore, similar questions found in the interview guides devised by the above-named researchers can be found in mine. The semi-structured interview gave me the opportunity to ask systematically each and every student similar questions and simultaneously follow the students in their answers. The aim of the interviews was above all to be able to study and dis-

cover more about the students' backgrounds, goals and expectations about the future, their thoughts about science and their thoughts about was going on in the classroom. However, as Cohen and Manion (1994) state, interviews should be complemented with other methods of gathering data. The interview was not the only way to find answers, but rather a help finding pieces of a larger puzzle.

The interview with the teacher was made a couple of weeks after the unit on physics and technology had ended. A semi-structured interview was used, inspired by the research mentioned above. Similar to other methods of gathering data, the interview with the teacher gave one (albeit important) angle. Seeing her in action also provided me with valuable information.

Questionnaire

There were various reasons for conducting a questionnaire (Appendix F). Firstly, I wanted to gather basic information about the students that could also give me an overview of the students' background. Secondly, I wanted to gather information about the students with different methods in order to validate the received information and use a method that could complement interviews and observations. In the decision to use a questionnaire I have also been inspired by the way Bourdieu (see e.g. Bourdieu and Passeron, 1990) worked and performed research, often using both quantitative and qualitative methods.

With inspiration from Esaiasson et al (2003), I used almost identical question as the PISA study unit that investigated students' backgrounds, perceptions about science and future. This gives me the possibility in the future to compare the students I studied with a much larger population. However, some questions not relevant to this study were taken away and some were added; some of the questions in the questionnaire were similar to those in the interview. The final questionnaire concerned amongst other things the students' background, their parents' socioeconomic status, their thoughts about science, school and homework.

The questionnaire was completed in a computer classroom under my supervision. This particular questionnaire was constructed by me and opens only for the students participating in this research. The students answered the questions in Artologic, a web based program. The answers from students were exported to the Statistical Package for the Social Sciences programme (SPSS) as well as to Excel spreadsheets which enabled further analysis and an overview.

In the interview situation I was able to ask following up questions which showed that their answers in the questionnaire was surprisingly often problematic and contradictory to the answers in the interviews. Nevertheless, when trying to understand the students' backgrounds I have carefully used the questionnaire together with interviews, as well as statements from the classroom, students or the teacher. The validity of the PISA questionnaires – particularly those regarding students' backgrounds - must however be strongly questioned.

Short reflections

Immediately after each visit to the classroom, I made short audio recordings about my experiences there. The recordings often included information or experiences from the small talks that I usually had with the teacher after each lesson. They were transcribed and added to other transcriptions. For example they helped me afterwards to relive the feeling I had when I left the classroom each and every lesson. The classroom gives you an infinity of experiences, some hard to write or pin down observationally. It can be communicative patterns, students' gestures, a glimpse, something that for some reason attracted one's attention. Sometimes these needed to be checked on or given a new angle of approach. However, what I discovered when analysing these short reflections was that there was often something else beyond what was seen immediately. For example, the way the girls talked and acted during the lessons: further analysis showed different pattern than those I saw at first. In this way, the reflections showed me that a well-founded analysis and focus was crucial for my aims. Things are very seldom what they look like at first glimpse with me as the only filter. The

reflections were crucial in the first step of the analysis, helping me to take the first step beyond what was taken for granted, the hidden and the unconscious, giving me (together with the analytical diary) an analytical point of departure.

4.4 Considerations

The overall aim of this thesis is to contribute to a more complex and multi-faceted description and analysis of inequalities in education. My view is that the research that I have undertaken is part of an on-going discussion in sociology of (science) education with the possibility of giving further explanation and description that could deepen the understanding of these complex issues. There is no aim to generalise the findings or prove statistically what has been going on in this particular classroom and with these students. Therefore the number of students is not important. Important though was the students' Swedish background (or other, however similar ethnic background) in order to be able to focus on social class.

I have chosen to collect data in a physics classroom. There are two main reasons for this. Firstly, physics is considered to be one of the subjects where most students fail (in terms of grades). Secondly, this subject is considered (as shown in chapter 2.3 and 3.3) to be strongly influenced by its sociohistorical legacy. The way it is portrayed and valued in the classroom as well as in society has large implications for those who fail or succeed. It is therefore a subject that needs closer investigation.

The numbers of students are not important, but why did some students choose not to participate in the study? Could it be that these students came from a lower social background and/or had problems or reasons that caused them to forgot or ignore the consent form? I have no evidence whatsoever. This is a problem - probably not only in my research - and I suspect that this is a general difficulty in many studies, yet seldom discussed. However much I should like to, there is no ethically sound way to bring in these students into the survey. Have I lost students that could give even

more nuanced descriptions and knowledge to the research questions?

I chose to work in the compulsory school[1] since I wanted to meet different kinds of students, rather than in an upper secondary class where choices and distinctions have already been made (see for example Svensson, 2001, 2006). In Sweden, eighth-graders are making their choices and there was a chance to hear the thoughts from all kinds of students. Moreover, year eight is the first year when students receive grades in Sweden[2]. Regarding science education, in year eight the science subjects in Sweden are often clearly characterised and classified which means it is easier to identify characteristics and features.

Another consideration was my former role as a science teacher. I want to emphasise that this role as a former teacher actually gave me more room to manoeuvre which in turn gave me even greater possibility to reach further in the ethnographic research process. I could enter the teacher's staff room knowing what was needed to be accepted there. I claim that as a researcher with a background in teaching there are ways of making use of one's knowledge about the language, dress codes, ways of standing, walking in the classroom, in the corridors. You have an understanding of curricula, timetables, the premises and - not at least - everyday life and how it affects the students and teachers. This could be a negative thing, clouding what is important and what is embedded (Bourdieu and Waquant, 1992). However, always bearing in mind a reflexive approach, I claim that it has been a resource and strong advantage in this research process.

Throughout the research process I have followed the ethical rules devised by the Swedish Council for Research in the Humanities and the Social Sciences (Vetenskapsrådet, 2002). The students, their parents, teachers and principal were informed before partici-

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[1] Private schools are not yet common in Sweden and students from differents social classes can often be found in the very same school or class.
[2] At this particular time students were given their first grades in year eight.

pating and the information to the parents and the students consisted of information about me, the research, as well as anonymity. The students were also reminded about the anonymity during the process such as in the interview situation. When returning to the classroom some weeks after the study, I showed the students the conference paper based upon some of the research I had done in the classroom. They could see with their own eyes that student work and dialogues were anonymous. Likewise, the students' identities are hidden in the excerpts and so are places and contexts. As the students participating in this study were young, parents' written permission was obtained. In addition, I wanted the students' written approval. If the parents and/or the students did not approve or if they did not reply, they were not included in the study. Most of the parents agreed to allow their child be video-recorded. However, the students did not approve of being video-recorded and consequently, this method was not used.

4.5 Processing the data

First phase of the analysis

In many respects, the first phase of the analysis is processing, arranging and structuring the data. Nevertheless, from the moment one enters the classroom an analysis, has started. I therefore denote this first phase as a part of the analysis (Arvastson and Ehn, 2007). As described earlier, the short reflections were one way to start the analytical process. In the beginning, I also kept an analytical diary in order to keep track and capture my thoughts, critical incidents, etc. when going through the collected data. The analytical diary became a dynamic paper which brought together the first initial analysis. However, the large amount of data needed to be structured and organized in order to be manageable. The first phase of the analysis therefore aimed to get an overview of this specific science classroom and the students.

Starting from the beginning of the unit on Mechanics, a number of the lessons were transcribed. Every lesson usually had two or three versions, depending on activities. When the two or three transcripts

were finished I merged them all into one file, which gave a good overview of what had been going on in the classroom, both from a teacher perspective as well as the student and group perspective. With inspiration from Lemke (1990), Mortimer and Scott (2003), and Mehan (1979) the lessons were divided into episodes in order to be able to study different and smaller sections of the lessons. After that, I started the analysis using five lessons. Further lessons were not added until the analytical procedure was more developed and I could more easily use the analytical tools on the data.

Like the lessons, the interviews were transcribed. At approximately the same time, the questionnaire answers were exported to SPSS and excel sheets. All the student responses were collated in one excel spreadsheet giving a good overview of, for example, the students' backgrounds and their differences and similarities. Data from this overview was for example used when describing the students (similar is done by for example Ambjörnsson, 2003), their relation and interest in science, their socioeconomic background and consequent differences and similarities.

The initial phase of processing the data was made entirely in Swedish. As stated by Nilsson (2010): "to translate naturally-occurring talk is a difficult task … the translations will not exactly correspond to the original meaning or form" (p. 56). There are words that are hard to translate. For example, the word *you* has two translations in Swedish: it could be you in singular (du) or you in plural (ni), which is an important difference. Another way to solve this problem was to have the excerpts checked by English speakers that were familiar with both a Swedish and English school context as well as educational research. In addition I have kept the original phrases from the students and the teachers (as well as myself) in the results chapter to increase authenticity (Cohen and Manion, 1994, Denzin and Lincoln, 1994).

Second phase of the analysis
If the first phase of the analysis was driven by an aim to get an overview of the data, the second phase was even more strongly

driven by the research questions and inspired by ways used by a number of researchers in performing their analyses. One example is Bernstein (1975) who asked for an analysis performed in different steps:

> I shall first examine the culture of the school. ... And I shall try to establish what this school culture is transmitting to the pupils. ... Second I will classify different kinds of family settings in terms of a family's perception of the school culture; how they regard it, see it and understand it. Third I shall consider various ways in which a pupil may be involved in the school and the forms of its transmission may shape the child's involvement in his role as pupil (p. 37).

In order to understand the larger picture, he divides the analysis into three steps. A similar approach can be found in the research done by Zevenbergen (2005) who has used both Bernstein and Bourdieu as theoretical frameworks. Working in sections, she first describes the practices of the field "whereby particular aspects of mathematics practice (assessment, curriculum, classroom ethos, teaching) are identified by the students as contributing to the construction of their views and dispositions towards school mathematics" (p. 612). Secondly she inserts the concept of habitus in the data, correlating it to the field.

Mills and Gale (2007) state that at the first level, crucial relationships between education and the political and economic systems of society can be found. At the second level, education can be seen as a field made up by agents and institutions (students, teachers, and staff) that have different positions and value in the field. At the third level, habitus could be found with its dispositions that correspond with the field from the individual student and (ultimately the family). They conclude that in the production of knowledge "it is important not to consider one level without also taking accounts the other two. However, it is not always methodologically possible to present analyses on each level simultaneously. To some degree they have to be separated" (p. 441).

The second phase was strongly driven by the research questions and inspired by the research presented above, performing the second phase in levels. In the end the aim was to see a complete picture that says something about social class in the science classroom. However progressing straight to the aim from the data (even though structured in first phase) was difficult. Instead, I worked closely with the research question and the analytical tools looking at different levels. The research questions and their relation with the analytical tools can be described in following table which also shows the three levels.

Table 4.2 Overview of the second phase of the analytical process

RQ 1	Analysed how this specific science classroom was situated in the field of science education
Analytical tools	Field
	Doxa
	Code
RQ 2	Analysed how this specific science classroom was organized
Analytical tools	Classification strong/weak
	Framing strong/weak
	Triadic dialogues
	Regulative discourse
	Instructional discourse
	Vertical discourse
	Horizontal discourse
RQ 3	Analysed what and who was valued and important (or not) in this specific science classroom
Analytical tools	Habitus
	Cultural capital
	Recognition rules
	Realisation rules

In the beginning, the second phase was carried out in the episodes. When describing the episodes I used the concepts of classification and framing, instructional and regulative discourse (RQ 2). An episode could, for example, be weakly classified due to the fact that the teacher has used content from other subjects. The episode could at the same time be described as weakly framed due to lack

of criteria or a student-controlled dialogue. Dialogues were also analysed and studied with the help of Lemke's way of looking at communication patterns. For example, was there a triadic dialogue and how could it be understood through instructional and regulative discourse?

Thereafter, episodes with similar pedagogies (such as strongly framed) were collated and compared. When doing this work it became clear that there were certain activities and practices that were more diverging, functioning more distinctively than others, making stronger impressions on the students for different reasons. For example, when comparing episodes that were strongly classified with weak framing, I found that many students lacked recognition rules (RQ 3). They could not understand the regulative discourse and therefore could not understand the pedagogy that was undertaken. Therefore, while working with RQ 2, I worked with RQ 3 and the students at the same time. Were there students who owned recognition and realisations rules for this particular episode and activity? Which students, and how did this become evident? What was their relation to the teacher and to each other? Similar procedures were carried out when looking at laboratory work, with different outcomes, however.

I claim that in order to be able to understand the interpretations and analysis made in the different levels in the result chapter, the descriptions of the students were important. These descriptions could be seen more as "presentation of the cast", the actors in this game or field and as such placed in the first result chapter. Looking back at earlier chapters (2 and 3), a number of things have emerged as important to bring forward in the description of the students (here briefly and somewhat roughly described and separated). Firstly (1), in the students' descriptions, their socioeconomic background was described. This gave one piece of the puzzle in understanding cultural capital and habitus and also which students had similar social and economic conditions and experiences (see for example Turmo, 2004, Marks et al, Bourdieu, 2010). Secondly (2), their interest, in education in general and in science in particu-

lar, was brought forward. I connected this to expressions such as where a student "feel at home", where you feel you have the necessary talent, where feel secure in what you are doing. It could also be the opposite, where you do not feel at home, like "a fish out of water" (see for example Bourdieu, 2010). Thirdly (3), in relation to interest, students' thoughts about their future and what they would like to do were described. This, in combination with interest gave one link to what kind of (dis)positions and vision they (and their parents) had for themselves in the future (see for example Bourdieu et al, 1992; Bourdieu 2010; Mills, 2008a). Fourth (4), in the descriptions of the students, their relation to each other has been taken into account. This has been done in order to understand their a) status and social rank (Bourdieu, 2010), b) their spielraum (Roth and Tobin, 2001), and c) how the students and teacher ascribed each other with (similar) properties, features or effect of this (Bourdieu, 2010). Finally (5) the descriptions of what the students knew about their parents' thoughts about the school and their future were brought forward. In relation to this, their thoughts and how they relate to school has been important (Bernstein, 1975). In the final descriptions however, there have been focuses on what becomes important in relation to the following practices and activities. Consequently, bringing forward a coherent story has been more important than describing all the details and gathered data.

Like many other researchers, one of the most challenging procedures in this process was to establish the concepts habitus and cultural capital, when elaborating on RQ 3. Reviewing the theoretical framework and earlier research has been crucial. For example, when trying to establish habitus and setting this into relation with social class, I have looked for moments or incidents in the episodes when student expressed or showed a "feel for the game". I have noted if they acted as if they were comfortable. Did they express unfamiliarity? What did they say about their own talent and interest? When did they express that they were not gifted or that they didn't understand? What did others (teacher, classmates) state about the students? How were they valued and assessed? However, habitus, cultural capital, recognitions and realization rules (con-

cepts that will be used when analysing the students in relation to the specific context) cannot be understood and analysed without their specific context (RQ 1) and in specific activities and practices (RQ 2). The levels are always intertwined and connected even though they have been differentiated in levels. In the end though, the analytical outcomes from the levels are presented as one story.

4.6 Presenting the analytical outcomes

How is it possible to present data "in ways that produce the maximum 'illuminations' for the readers" (Willis and Trondman, 2002, p. 39)? How is it possible to produce "a concrete sense of the social as internally sprung and dialectically produced" (p. 39)? This is not easy. Nevertheless, with inspiration from e.g. Ambjörnsson (2003) that launches from her results chapters with a description using few analytical tools, I have chosen to begin the results chapters and their subsections with descriptive parts where few or none of the analytical tools are brought into the text. These parts are thereafter followed by sections where the analytical tools were introduced. I have seen an advantage in first describing the practices, activities, students and then adding the analytical tools. By doing this I aim to "describe and explain very complex realities in fairly plain terms before clearly distinct theoretical framings, interests, and critiques … before the theory kicks in" (Marcus, 1998, p. 18). It has been a way to let the produced data 'breathe' in relation to the analysis and at the same time let the readers 'breathe' with the data (Marcus, 1998). Doing this has also been important trying not to fall into normative interpretations and make it possible for me as well as the reader "to construct empirically grounded and theoretically informed connections" (Power, 1998, p. 25).

In the result chapters the analysis and the study of the different levels were brought together into one story. One aim to do this was to avoid deterministic statements; rather to show processes, a fluid correlation between e.g. the room and room to manoeuvre, between social class and the science class. I saw a risk when writing the result chapter that too much focus on the individual student

would cause deterministic interpretation. Like Bäckman (2003), I did not primarily want to create understanding about the students as agents, rather as agents in processes. The descriptions of the students are there not to show deterministic relationships; they give flesh and blood to the processes. In the end, the aims of the result chapters was not to generalize or to show one definitive, complete picture, "ethnographic truths are … inherently partial – committed and incomplete" (Clifford, 1986, p. 7) but rather to show practices, activities and students that could deepen our understanding of social class in the science classroom.

When presenting the dialogues, the aim has been to keep all original phrases as well as translations. It has also been an aim to present the dialogues as authentic as possible. However, when overlapping between speakers was minimal it has generally been disregarded and taken away (such as "yes" or "mm") in the excerpts. Following transcription, a legend (with inspiration from Hanrahan (2006) and Willis (1977)) has been used when presenting the dialogues:

- **bold** type represents emphasis;
- '_' refers to a citation the student makes, such as reading from a book or a white board;
- (_) refers to something that the students and/or the teacher do, such as laughter, a gesture or a use of specific voice;
- [_] refers to words that could not be deciphered, such as inaudible words, or short explanations inserted by the author;
- … pause;
- (…) material edited out;
- (*) from field notes, not transcription

In the following three chapters the results of the research process will be described. Chapter five sets the scene and describes and analyses the students and the teacher, the classroom and its context. The sixth chapter focus on the science dialogues, i.e. science

as a communicative subject. The subsequent chapter focuses on science as a practical subject and laboratory work.

5. ON THE FIRST FLOOR

5.1 Class 8D

This year, Westvillage compulsory school had five classes in year 8; one of the classes is 8D. In following chapter, the class, the classroom, the teacher, the school, and Westvillage School will be described and analysed. Of the twenty-one students in 8D that Carin teaches, eighteen students were included in the study. Seven[1] of these students will firstly be described in order to represent some of the important actors in the classroom.

Joshua – doing the right thing

Joshua is a frequent participant in classroom dialogues and often contributes with questions or answers. Carin thinks Joshua is achieving well in the classroom, but he is not performing well in written tests which surprises both Carin and Joshua's parents. Carin says that "*you never really know with him, [Joshua], but he is struggling on*" (*"Man vet inte riktigt med honom [Joshua] men han kämpar på"*). According to one of Joshua's classmates, Joshua is one of three students that Carin has deliberately placed with classmates often ascribed as low-status. Joshua is one of the students often consulted by Nicholas and Matthew for a calculation or an answer. When the assignment is to build a car, Nicholas and Matthew repeatedly ask Joshua if he wants to join them. Despite

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[1] The following persons will not be presented in detail but nevertheless participate in the study: Michael, Benjamin, James, Connor, Jack, Molly, Emily, Charlotte, William, Danielle, Amy.

this, Joshua often works by himself and often chooses to do exercises and laboratory work by himself.

Joshua dreams about making money and wants "*a job with a good salary*" ("*ett jobb som man tjänar bra på*") or "*if you are lucky you might sell some [photos]*" ("*har man tur så kanske man kan sälja nån [bild]*"). Joshua is interested in photography, but he thinks however that it would be nice to have photography as a hobby and that "*you have a job from morning until afternoon*" ("*sen har man ett jobb från typ morgonen till eftermiddag*"). It doesn't matter what kind of job, according to Joshua. They have not spoken a lot at home about his future and Joshua doesn't know what his parents think about his future. Joshua says he wants to follow in his father's footsteps and become a manager, even though he does not know if it is fun or what the job entails exactly. Joshua states: "*Well fun… I don't know but, I don't usually stay with him so I don't' know what he does exactly*" ("*Öh, kul och kul det vet jag inte men, ja jag bruka inte va med han. Jag vet inte vad han gör precis*").

According to Joshua, it is his father that helps out with homework; "*usually he knows a lot*" ("*han brukar kunna mycket*") Joshua states. If Joshua does not understand something he "*usually goes to the Internet and checks facts first and if I don't find it I ask my dad*" ("*gå in på internet och kolla upp fakta först så om jag inte hittar så frågar jag pappa*"). Joshua seldom consults his friends in the classroom. Joshua says of his friends:

> Joshua: Some of them are… well, they don't bother me. No, I am not distracted if somebody's carrying on or something like that. And they don't really help me either, well they are…
> Anna: Yes, but you go your own way in some way? (…)
> Joshua: Kind of. Yes. It feels better, just, yes, it feels safer that way.
> Anna: Yes. Safe for your grades, or?
> Joshua: Yes. It depends on how much I understand … a lot.
>
> Joshua: En del är väl. De stör mig inte. Nä jag störs inte av om nån håller på eller sånt. Och dom hjälper mig inte direkt så, dom är väl … ja.

Anna: Ja men du kör ditt eget race lite? (…)
Joshua: Typ. Ja. Det känns bättre så att bara, ja det känns säkrare så.
Anna: Ja. Säkrare för ditt betyg eller?
Joshua: Ja. Beroende på hur mycket jag förstår … Mycket. (Excerpt 5.1, interview with Joshua)

Instead of consulting his friends he works by himself or asks the teacher. Joshua thinks that *"if you have a really good teacher who explains things in a good way that's great"* *("om man har en riktigt bra lärare som förklarar bra så är det ju jättebra")* and conversely *"then it's worse, then it's better if they give you something to do"* *("då är det ju sämre, då är det bättre med uppgifter")*. He says that if he were the teacher he would talk things through, use the whiteboard a lot and then let the students take notes.

Joshua wants to continue to upper secondary school in one of the larger cities, even though he doesn't know what kind of program to choose for the moment. What motivates him to try to get good grades is the chance "*to get into an upper secondary school that you need good grades to get into*" *("det är det att komma in på gymnasium som man behöver högre betyg på")*. Even though Joshua thinks it is important to study science, he says that he is not especially interested in it. He does not want to work with something that has to do with advanced science. Despite this, he is often involved and committed in various practical tasks and dialogues in the classroom. For example, during a project when the students build a car, Joshua wants to get the very best grade and says to his classmate " *We'll bloody well get PWSD[1] on this one!"* *("Vi ska fan ha MVG på detta!")*. In the end he gets PWD+ (VG+), the best grade of all awarded to students doing that project.

If Joshua seeks to work by himself, Lucy on the contrary always wants to work with her friends.

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[1] PSWD= Pass with special distinction, highest possible grade at that moment in the Swedish educational system. There is also Pass with distinction (PWD) and Pass (P). Swedish student usually use abbreviations when talking about their grades with each other. Sometimes they add to that a + (Plus) to emphasize that it is a very good grade.

Lucy - "with you or not"?

Lucy often sits next to Laura and three other classmates. They are a group of friends that often come and sit together. They sometimes see each other outside school, listening to music, playing computer games and according to Lucy *"hang around and stuff like that" ("hänger och sånt").* Lucy, Laura and *"well, some of the boys" ("så typ några killar")* have been in the same class for many years and they have known each other for a long time. Most of the girls have similar socioeconomic backgrounds: their parents have similar occupations and levels of education. Lucy and one of the others have divorced parents and they live most of the time with their mothers.

Lucy prefers not to work by herself. One day when Lucy reads the daily program on the whiteboard, she says with anxiety*: "'plan to build something in technology', not by myself, I'll get DAMP" ("'planera att bygga nåt i teknik', inte själv, om vi ska bygga själv kommer jag få damp").* Later on in the very same lesson, she declares to her group: *"We work in teams"* (*" Vi jobbar i grupp"*). A common field note regarding Lucy and her group is that they often giggle and talk about things other than the subject in focus. Lucy admits that she and her friends sometimes influence each other in a negative way: *"It is sometimes a bit messy and stuff so you can't do anything. (…) Ah, and as well, you can't manage by yourself",* (*"Ibland är det lite stökigt och sånt så man inte orkar göra något. (…) Ah, dels så orkar man inte göra något själv").*

When asked if they talk about science at home, Lucy laughs. She has no clue whatsoever about what her parents think about science. However they have talked about her choice of occupation. Lucy wants to be a policeman and her parents are worried she will not make it, since she is scared of the dark; *"We have talked about it at home a little. Kind of, will you be able to do it?" ("Vi har ju pratat lite om det så. Alltså klarar du det?").* Lucy thinks she will get used to it and after ninth grade Lucy aims to enter an upper secondary program which will help her become a policeman.

Lucy does not know if she is interested in science, but states in the interview that her interest is *"so-so"* *(”sådär”)*. She thinks it is "*more fun to make things than to read a book*" (*"roligare att bygga än att läsa en bok")*. Lucy belongs to one of the students who most clearly states her resistance to science in the questionnaire. For example, she strongly agrees that science will not be important to her and that she will not work with or continue into higher education with a focus on science. Nevertheless, Lucy states that grades *"are quite important, if you want to have the chance to get into the program you want to, then you need them"* (*"de betyder ändå rätt, mycket för om man vill komma in på det man vill så måste man ha dom")*. Her expectations in science is to reach "*Pass at least (…) or Pass with distinction maybe"* *(”Godkänt betyg i alla fall (…) eller VG kanske*") later on in ninth grade.

Lucy considers herself as "*kind of caring and so on. Calm."* ("*typ omtänksam och så. Lugn*"). What is visible in the classroom is her bad self-esteem and that she blames herself when she fails to understand something. When Lucy and some of her friends enter the classroom one lesson and find out it is time for an unscheduled test, Lucy exclaims:

> *Lucy: I don't understand anything.*
> *Matthew: Good, way to start, before you even get inside the door: 'I don't understand anything'.*
> *Lucy: I don't understand anything.*
>
> *Lucy: Jag kan ingenting.*
> *Matthew: Bra, bra början, innan du kommer in: 'Jag kan ingenting'.*
> *Lucy: Jag kan ingenting. (Excerpt 5.2, lesson 2010-02-11)*

Similar exclamations can be heard in a subsequent lesson when Lucy, even without trying to understand, states "*I don't get this kind of question"* ("*Alltså jag fattar inte såna frågor")*. Carin is a little uncertain when it comes to Lucy. She considers her haughty and mean. When reflecting on her teaching after one lesson, Carin states that *"You don't know if she is with you or not. … I can get so irritated with these girls, Lucy and Molly. But I don't think they*

understand" ("*Man vet inte hon är med dig eller inte. … Jag kan bli så irriterad på dom där tjejerna, Lucy och Molly. Men jag tror inte att de förstår*") *.

Lucy seems to lack both interest and self-esteem and does not like to work by herself. This is not the case with Matthew.

Matthew – happy and humorous

Matthew is very talkative, not only during the interview but also in the classroom. He often jokes around with his classmates or with the teacher. He is often the one who raises objections or asks questions. Sometimes he shouts to Nicholas on the opposite side of the classroom, asking about something or checking an answer. Carin sometimes corrects Matthew or asks him to be quiet but it never results in an awkward or tense moment. Matthew describes himself as social and positive, however he wished he was a bit more organised and more like his sister, who he says is well-behaved and bright.

Matthews's mother is one of the few parents in the class that has a university education. Matthew talks about his family many times during the interviews and states for example:

> *Matthew: But also, I have my parents that matters a lot. It almost feels like they are even more important [than school] because they are giving me self-confidence all the time.*
> *Anna: Yes, so it is them that give you the inner strength in some way?*
> *Matthew: Mm. (…) So it is schools that teach me stuff.*

> *Matthew: Men så har jag ju mina föräldrar som spelar ju in. Det känns nästan som att dom spelar ännu större roll [än skolan] för dom sätter ju självförtroende och så på en hela tiden.*
> *Anna: Ja så det är dom som ger dig den inre styrkan på något vis?*
> *Matthew: Mm. (…) så det är skolan som lär mig grejer. (Excerpt 5.3, interview with Matthew)*

Nicholas and Joshua are two of the students who often work or talk with Matthew. Matthew says that Carin is the first person he

asks if he does not understand, or else it is Nicholas or Joshua. Carin considers Matthew to be nice, ambitious and hard-working, but *"weak" ("svag")* and lacking independent thought, his *"own thinking" ("eget tänk")*. She compares him with Nicholas, who she considers "*good*" *("bra")* and able to draw his own conclusions. Carin also compares him with Liam, who she thinks can hear something once and then is able to draw a conclusion. Matthew, though, has to work for it, says Carin.

Matthew wants to have a practical job in the future, to perhaps work as an electrician or a builder. He is the only one in the class that in a reflective way talks with me about what his parents think about his future. They think it is important that he becomes something that he could enjoy. " *Well, they have said to me (…) they do not care really what we are going to be, the important thing is that we like it. And that we feel that we are doing the best we can in school. Our parents are happy if we only just get a Pass if we're doing the best we can, then they are proud. Yes, that's enough for them"* (*"Asså dom har sagt till mig (…) men jag tror dom bryr sig inte riktigt vad vi blir bara vi trivs med det vi gör. Och att vi ska känna att vi gör det bästa vi kan typ skolan eller nåt sånt. Våra föräldrar blir bara glada om vi bara får ens godkänt, vi har gjort det bästa vi kan, så är de jättestolta. Ja så det räcker för dom"*). The family supports Matthew and he uses the word "we" when talking about homework, for example. He says that it is usually the whole family that helps him with homework when Matthew and his sister sit at their dining table listening to music and doing their homework together.

When it comes to science, Matthew enjoys the practical side and he is very active and committed to laboratory work during lessons, wanting to solve problems. However, when we discuss his interest in science he says that he is *"not very interested but I'm (…) most interested in, well it's when we do laboratory work, when (…) we for example construct such things like we're doing now. Well, that's when it's best"* (*"inte jättejätte intresserad men jag (…) mest*

intresserad av, det är när vi laborerar, när vi (…) gör nåt till exem-
pel bygger saker som vi gör nu. Ja då är då är det som roligast".)

Matthew is very talkative in the classroom and often participates in
the dialogues and activities. So is Liam as well, however in another
way.

Liam –"penalty point"

Liam describes himself as chatty and lively. In school though, he
feels that he is often falsely accused: "*It's just like with the police,
if you have a penalty point on the files then you always end up in
the shit. It feels just as if you have a penalty point here in school as
well. If you get caught for one thing then you get caught for every-
thing. That's the way it is in school, if I yell at a teacher or hit
someone it's as if I get a penalty point here in school, so if some-
thing happens something here in school, it's always me or my
friends who are the prime suspects.*" ("*Det är som hos polisen, har
man en prick i registret så hamnar man alltid i skiten. För det
känns precis som man har en prick här i skolan alltså. Åker man
dit för en sak åker man dit för allt. Det är så i skolan liksom, skri-
ker jag åt en lärare eller slår till en så är det precis som att jag får
en prick här i skolans register, så händer det någonting med skolan
så är det alltid jag eller mina kompisar som blir huvudmisstänk-
ta*"). Nonetheless, he does not feel that he is unfairly treated. Liam
says *"No, I don't care, I have learnt to take care of it."* ("*Nä jag
bryr mig inte, jag har lärt mig att ta hand om det.").*

Liam says that he can get really "*pissed off*", starts to scream and
sometimes go into fights. Liam says *"I don't really know why I get
so pissed off. Mum, Dad, the school have tried to get help for me,
(…) yes that kind of test, like that type of concentration tests and
stuff"* ("*Jag vet egentligen inte vad jag blir sur för. Mamma, pappa
skolan har sökt in mig för det, (…) ja såna tester, såna typ kon-
centrationstester och sånt*"). Liam thinks it would be good to find
out because *"yes it's pretty tough in some, some situations. When
you try to stay calm and then you can't, I can't control things so it
ends up like crap."* (*"ja det är ju rätt så jobbigt i vissa, vissa lägen.*

När man ska försöka hålla sig lugn så går det inte, jag kan inte kontrollera saker så blir det bara skit"). Liam thinks Carin is nice and is to one of the teachers who understands him and can stay calm. In many lessons, Liam often randomly calls out vulgarities or rude words from his place in the back of the classroom. However, nobody seems to care, neither Carin nor his classmates. Sometimes he talks out loud about the scientific content in focus. Carin considers Liam to be a bright student and believes that if he could "channel his aggression out of his system" ("*kanalisera ut sitt*") than he would get good grades. Carin says Liam belongs to one of the few students in class 8D that could plan a career in science "*if he can get his life on track*" ("*om han får ordning på sitt liv*"). "*He is smart, he will figure things out*" Carin states, "*he might yell at his boss in a company, but he will make it*" ("*han kommer kanske skälla ut chefen på ett företag men han kommer klara sig*"). Carin talks about Liam with a lot of empathy. She talks about a situation when she had to ask him to leave the room for misbehaviour, but Liam did not want to leave. According to Carin he said *"No, I won't, because as a matter of fact I want to stay for this lesson with you"* ("*Nae det gör jag inte, för jag vill faktiskt ha lektion med dig*"). Liam often comes late, but he sometimes stays after the lesson, working further or finishing his task, not minding that his classmates have left and that his other lessons have started.

Liam thinks he will continue to upper secondary school in Westvillage after ninth grade. He is thinking of becoming a plumber or *"some kind of job that will always be needed, maybe some kind of plumbing. There are always pipes in houses, you always need plumbers"* ("*nåt jobb som alltid kommer att finnas kvar , det bör finnas något sånt där rörgrej. Det finns ju alltid rör i hus, det kommer alltid att finnas*"). He has not talked with his parents about his future so he does not know what they think. But one dream is to win the lottery and then *"live the life"* ("*bo rikt*").

Liam is aiming for the grade of Pass and thinks he going to get Pass+ or Pass with distinction next semester. He considers that he has been fairly evaluated by Carin. Liam believes that what is decisive for a good grade is *"how I behave in class and how I work,*

how I write, I mean how much I write" ("*Hur jag är i klassen och hur jag jobbar, hur jag skriver asså hur mycket jag skriver*"). Liam expresses more clearly than many others some learning strategies such as *"focusing, sitting quietly and listening, writing or whatever I am doing"* ("*fokuserar, sitter tyst och lyssnar, skriver eller vad jag gör*") and if he were to be the teacher he would "*show an example first of what you should do (…) and then some ways of how to connect stuff and some good examples about how you can do it and then give hand outs that tell you what to think about and then let them work by themselves"* ("*Visa först ett exempel hur man kan göra (…) och så några sätt hur man kan koppla ihop grejer och några bra exempel om hur man ska göra och sen ge ut ett papper där det står vad man ska tänka påoch så låta dem göra det själv*"). When we discuss science he says that technology is the most interesting subject. He thinks science is difficult; still he belongs to one of the students who thinks that science is important for society, his further education and occupation, and that it will improve his chances of better jobs. In addition, Liam considers school important for his future because *"it is there that you learn the basic things, because when you continue on then you know it gets harder with maths, science and social science"* ("*för det är ju där man lär sig grunderna ju för när man kommer upp där så ska man ju veta det blir jobbigare med matte och NO och SO*"). Liam says that "*it becomes harder if you have not learnt and you can't get into the school where you want to get in"* ("*Man kan ju inte komma in var man vill*") and "*if you have Pass in all subjects or Pass with distinction then you can get a good job, because if you haven't passed then there's hardly any jobs"* ("*har man alla alla godkänt eller VG så får man ju rätt så bra job, för om man har IG så får man ju nästan inga alls*").

Liam seems to have realized that the way he acts in the classroom influence the way he is treated and his grades. Has Rebecca made the same correlation?

Rebecca - unfair in pairs

Rebecca can always be seen together with Charlotte with whom she always sits and works. Even though Rebecca and Charlotte have not been friends for a long time, they use the same gestures and wear similar clothes; they also talk more about clothes and make up than the other girls in the classroom.

Rebecca says to me that she does not know if she is interested in science, nor what kind of role the school plays for her future. Rebecca states that *"of course I want to have more than Pass"* ("*jag vill så klart ha mer än godkänt*") and hopes for a PWD. She thinks it might be difficult, but she seems to know what it takes to get PWD: "*Take part in the lessons. Do what you should, make it good as well*" ("*Va med på lektionerna. Göra det man ska, göra det bra liksom.*"). When it comes to grades, Rebecca does not think she is fairly evaluated:

> *Anna: Do you think you are fairly assessed in science?*
> *Rebecca: Yes, or some others they just do other things in class and stuff ... and get the same kind of grade as me even though I sit and work ... anyway working most of the time ... and do what we have to do... and we get the same grade as those who just are so ... but I do not know.*
> *Anna: So it is not really fair in that way?*
> *Rebecca: Well.*
> *Anna: So you actually do what you should.*
> *Rebecca: Mm.*
> *Anna: and the others do not but they still get Pass?*
> *Rebecca: Yes.*
>
> *Anna: Ja. Tycker du att du blir rättvist bedömd i NO?*
> *Rebecca: Ja eller som vissa andra som så som håller på på lektionerna och sånt ... liksom får typ samma betyg som som jag som typ sitter och jobbar ... i alla fall sitter och jobbar för det mesta ... och gör det vi ska ... får samma betyg som dom som bara håller på så ... men jag vet inte.*
> *Anna: Så det känns inte riktigt rättvist på det viset?*
> *Rebecca: Njää.*
> *Anna: Nä att ni faktiskt gör det ni ska.*
> *Rebecca: Mm.*
> *Anna: och de andra gör inte men de får ändå liksom G.*
> *Rebecca: Ja. (Excerpt 5.4, interview with Rebecca)*

Rebecca thinks she deserved a Pass with distinction on the unit on mechanics. Carin, however, does not think she has reached the goals regarding theory and oral activity. Carin thinks Rebecca and Charlotte are both hard-working and diligent lack independent thought (*"eget tänk"*). Rebecca and Charlotte are always together, work together and talk about their grades using in terms of *"we"* (*"vi"*) in many dialogues, seeing each other as twins:

> Charlotte: *We are sort of twins, so we think in the same way, so we'll both get PWD.*
> *(Giggling)*
> Rebecca: *So we are like one person.*
>
> Charlotte: *Vi är i och för sig tvillingar, så vi tänker likadant så vi kommer få VG båda två.*
> *(Fnitter)*
> Rebecca: *Så vi är som en person. (Excerpt 5.5, audio recording, lesson 2010-03-01)*

In the classroom Carin occasionally encourages Rebecca and Charlotte to help Connor (Charlotte's twin brother) who sits in front of them, even though he more often disturbs them.

Rebecca does not express any dreams about her future and says that she has no clue what her parents thinks about her future, the school and science. Like Rebecca, Charlotte has not had many thoughts about the future. Charlotte though dreams of becoming an artist. Like Rebecca, she does not know what role school will play in her future. Again like Rebecca, she is uncertain whether she gets fair grades. Charlottes states that "*when me and Rebecca are working and follow the instructions and then we only get Pass I don't know why*" ("*när jag och Rebecca jobbar och följer beskrivning och så får vi ändå bara G, vet inte varför det blir så*"). During one lessons Rebecca states, supported by Charlotte:

> Rebecca: *We are always fucking working.*
> Charlotte: *Yeah, exactly.*
> Rebecca: *We don't talk, we don't. Now I'm pissed off.*

Rebecca: Vi jobbar fan alltid.
Charlotte: Eller hur.
Rebecca: Vi pratar inte, ändå, det gör vi inte. Nu blir jag sur.
(Excerpt 5.6, audio recordings, lesson 2010-03-01)

Rebecca always works with Charlotte, and wants to do that. Laura often works with her team as well however sometimes tries to do things in her own way.

Laura - shy and quiet

Laura lives together with her father, mother and her siblings on a small farm with cats, dogs, sheep and horses on the outskirts of Westvillage. Her farther works as a smith and also takes care of the farm. Her mother works as consultant for farmers. At first Laura thought about being a veterinary. However, she does not like to see animals die and so instead she is thinking of working in day nursery since she likes small children.

Laura thinks that grades mean a lot: they will help her to get into upper secondary school and good grades will also give her the freedom to choose a program that she is interested in or that gives her more options. Laura wants to reach PWD in her science subject, which she considers is a fairly high goal. She expresses interest in science as *"don't know, ok I suppose"* (*"vet inte, rätt ok"*).

Laura says about herself that she is *"kind, always trying to do the best I can" ("snäll, gör alltid det bästa").* Laura is seen by her small group of friends as someone to ask for help. For example, one of the other students says to Laura before a test: *"Then I'll text you"* (*"Då smsar jag dig"*). This is a picture that correlates with Carin's opinions of Laura and the group. During one lesson, Laura asks the teacher about an exercise. Lucy says to Laura and the group that they understand. But it turns out they have not understood and Laura is the one who tries to find out. In the end Laura gets the highest merit ranking compared to her closest friends. Lucy gets the lowest. Even though they do not have similar goals regarding grades, the girls keep together and Lucy is keen on keeping them together: *"Well hey there, are you working ahead of us*

now?" ("*Men hallå, har du jobbat ifrån oss nu?"*) she chides Laura when they are working on a hand out.

Laura is often silent during lessons and Lucy says during one lesson that "*Laura does not talk*" ("Laura pratar inte") when Laura and her group discuss why they did not get good grades on the oral activity. Laura does not talk much during lessons but with these friends she talks more. Laura herself says about her classmates that "when everybody is quiet and listening, then they help out *(laughter)*" ("*när alla är tysta och lyssnar, då hjälper de till (skratt)"*).

If Laura is shy and quiet, not expressing her thoughts in the classroom, Nicholas does not hesitate in speaking about want he thinks.

Nicholas -"kind of smart"
Nicholas is considered by Carin as "*kind of smart*" ("*rätt så smart*") and having an "independent mind" ("*eget tänk*"). He is also regarded as one of the students that can help other students. Nicholas is often consulted by Matthew and Joshua and in many ways constructed as one of the students with best learner status in the group. For example, Carin sometimes asks Nicholas about his point of view:

> Carin: Nicholas?
> Nicholas: He moved the earth with a lever.
> Liam: Yeah yeah sure sure.
> Carin: Did you hear? (…) Did you hear what Nicholas said?

> Carin: Nicholas?
> Nicholas: Han lyfte jorden med ett spett.
> Liam: Ja ja visst visst.
> Carin: Hörde ni det? (…) Hörde ni vad Nicholas sa? (Excerpt 5.7, audio recordings, lesson 2010-01-29)

Carin is using Nicholas as a sounding board, legitimizing his answers; he is given room to manoeuvre both by students and the teacher.

Nicholas says in the interview that his interest in science is *"crap"* (*"skitdålig*t") and *"Yes, I hate science" ("Ja jag hatar NO")*. He also thinks that due to his lack of interest he will not get high grades: "*PWSD is kind of hard because I haven't got any interest in this at all and I am not that good in it either"* (*"MVG är lite svårt för jag har liksom inget intresse alls och jag är inte så där jättebra i det heller*"). He states that in the end *"I would be really happy if I got PWD in science" ("ett VG är jag jättenöjd med i NO*"). Nevertheless, what is visible and expressed during the lessons is that he aims for something else. For example, he is stressed over having to work with Liam, which he thinks might reduce his chances to reach PWSD. During other lessons it is not uncommon that he, Matthew and Joshua get involved in discussions regarding grades. In addition, Nicholas emphasis in a discussion with Carin that he has done what it takes to reach the highest grade. His way of acting indicates that he likes to act as a sounding board and be part of dialogues. He appears to enjoy laboratory work and sometimes becomes deeply committed. The way he construct himself though is complex, sometimes he expresses a kind of lazy or a resistant attitude in the classroom and can say things like *"I wrote something at least. (…) Now Carin I have done two questions, you should be satisfied now"* (*"jag skrev något i alla fall. (…) Nu Carin har jag gjort två frågor, nu borde du vara nöjd")* or leaves a test as fast as possible without trying hard.

Despite this attitude, the grades are important to him: they mean merit ranking points to be used when entering upper secondary school. Moreover, good grades mean a reward *"PWSD, then I'll get some money, from mum, dad" ("MVG, så får jag pengar, av mamma, pappa").* In the end, Nicholas receives PWSD in many subjects, PWD in physics and chemistry and gets the highest merit ranking of all students in 8D. Nicholas says that school gives you an education that will increase your chances of getting a good job. But if he could choose for himself he would like to be coach for a football team. When it comes to Nicholas' future, he states of his parents that *"yeah, I think they'll let me choose whatever I want"* (*"ja, jag tror att dom är rätt fria och låter mig välja vad jag vill"*).

When Nicholas works with Matthew they have a fluent, engaged discussion. When working with another student, Michael, there is another tone in their conversation. Sometimes Nicholas bosses Michael around, often calling him by his surname, Brown:

> Nicholas: Get the ruler, Brown
> Michael: I think she has them.
> Nicholas: Can't you go and get the ruler!?
> Michael: Can't you do anything by yourself?
>
> Michael: We have to tie this one up.
> Nicholas: No, we don't have to.
>
> Nicholas: What are you doing now? (Irritated)
>
> Nicholas: What did you get Joshua? … Brown, pencil! Brown, pencil! Brown, pencil!
>
> Nicholas: Hämta linjalen Brown.
> Michael: Jag tror hon har.
> Nicholas: Kan du inte hämta linjalen!?
> Michael: Kan du inte göra något själv?
>
> Michael: Denna måste vi binda.
> Nicholas: Nej det måste vi inte.
>
> Nicholas: Vad gör du nu? (Irriterad)
>
> Nicholas: Vad fick du dina till Joshua? … Brown, penna! Brown penna! Brown penna! (Excerpt 5.8, audio recording, lesson 2010-02-12)

When talking with William, Michael's best friend in the classroom, Nicholas denotes William as *"You stupid ass"* (*"Din dumme åsna"*). Nicholas not only demarks himself against William and Michael with the way he talks, he also emphasises the difference between their mothers and that Michael is not as smart as him:

> Nicholas: We saw your mother.
> Connor: What does your mother do Brown?
> Michael: Same fucking job as Smith's [Nicholas] mum.
> Connor: Fish counter?
> Nicholas: But my mum is boss there.

Connor: In the fish counter?
Nicholas: Yes (laughter with some embarrassment)
Connor: What shop?
Michael: The co-operative here in Westvillage.
Connor: Man, that shop is crap.
Michael: You earn one penny per minute. No ten pounds per min… or not per minute, per hour.
Connor: That's crap.
Michael: My dad earns 13 pounds but, I don't get shit for being here in school.
Nicholas: Well, wow Brown you've figured that out all by you self, right? (ironic voice)

Nicholas: Vi såg din mamma.
Connor: Vad gör din mamma Brown?
Michael: Samma jävla jobb som Smiths [Nicholas] morsa.
Connor: Fiskdisk?
Nicholas: Min mamma är boss där.
Connor: I fiskdisken?
Nicholas: Ja, haha (verkar nästan skämmas men skrattar).
Connor: Vilken affär?
Michael: The co-operative här i Westvillage.
Connor: Du den är skit den affären.
Michael: Man tjänar en spänn per minut. Nej 125 spänn i min, eller inte i minuten i timmen.
Connor: Det är dåligt.
Michael: Min farsa tjänar 150 men, jag tjänar inte ett skit för g
Nicholas: Men wow Brown det räknade du ut helt själv va? (ironisk röst) (Excerpt 5.9, audio recording, lesson 2010-02-12)

Seven students have been described: Joshua, Lucy, Matthew, Liam, Rebecca, Laura and finally Nicholas. They represent some of the actors in this playing-field. Their backgrounds, their thoughts and what they express have been described. These descriptions allow their resources, their possibilities and their relations to shine through. Nevertheless, these descriptions need to be situated (elaborating primarily on research questions 1 and 2). Therefore, before going into a deeper analysis of these students, they will be placed in a context. The following sections will describe the school and the village, the classroom and the teacher.

5.2 The school and the village

The students are standing in the stairwell that leads up to the science classroom when the teacher Carin and I arrive. They have had a break and are now hanging against the railing, waiting for Carin to open the door. Grade nine has their lockers next to the stairs in the corridor; they are joking around with the younger students in grade eight. *"Hi Carin!"* says Matthew. Rebecca and Charlotte are facing each other, peering suspiciously over their shoulder towards me. Joshua and Nicholas do not care, continuing to talk about their latest computer game. The stairs and the premises are quite worn, the school is getting old and soon a long-awaited renovation will start. This particular staircase leads only to the two science classrooms and the preparation room in between. You cannot enter this area without a key: the glass door prohibits everybody except the teachers. Entering the locked door, you face a small dark corridor lined with cabinets filled with equipment, gadgets and material to be used in laboratory work. There is a faint odour from the old cabinets and the science equipment, the bottles and the instruments. Student projects about energy, the planets, the liver, lungs and skeleton hang on the wall. Talking loudly, Matthew and the other students turn left, entering their science classroom. Walking closely together, speaking quietly to each other, Lucy, Laura and their friends find their places in the second row of the classroom. Liam is shouting down the corridor. In about fifteen minutes he will turn up in the classroom.

The school is the only alternative for the students in 8D. There are no other secondary schools in this municipality and there are no private schools. The small town, Westvillage, is placed some 20 to 30 kilometres outside three larger cities, functioning as a suburb. Most of the students - except Laura who lives on farm close by - live in the small town. Every day, a large number of the residents commute mainly to two of the nearby cities and this is the case with some parents of students in the class. Those who have their occupation here in the small town or nearby work foremost in trade and manufacturing/production (handel och tillverkning) in

some way. A large group of the residents work in a nursing institution or at hospitals, but most of them in other cities. Carin, the science teacher, says that there are many self-employed people *"out here in this town"* *("ute här i det här samhället"),* but most of them are workers, basically she states. "People *with university degrees don't live here*" *("människor med universitetutbildning bor inte här")* she continues. The statistics reflect this too. The year when the students in this study left the compulsory school, 53 % (51 % in general in Sweden) of the students had parents without higher education. 46 % of the students had parents with higher education. The correlation between parents' educational level and students' grades could be seen here in Westvillage, similar to the rest of Sweden. 96 % of the students in Westvillage whose parents had higher education reached pass in all their subjects. 70% of the students in Westvillage who had parents without higher education reached pass in all subjects (SNAE, 2012).

Even though there is one upper secondary school in Westvillage, many of the students want to enter upper secondary school in the larger nearby cities. Matthew says when asked about where he would like to go to upper secondary school:

> *Matthew: No I would rather choose Eastcity actually.*
> *Anna: You would rather choose in Eastcity, how come?*
> *Matthew: I want to get out of Westvillage (laughter).*
> *Anna: Why do you want to get out of Westvillage?*
> *Matthew: Well you see there is this boring atmosphere here.*
> *(…) Same things all the time.*

> *Matthew: Nä jag vill ju hellre gå i Eastcity faktiskt.*
> *Anna: Du vill hellre till Eastcity, varför det?*
> *Matthew: För jag vill ut ur Westvillage. (Skratt)*
> *Anna: Varför vill du ut från Westvillage?*
> *Matthew: Asså det är så tråkig stämning i Westvillage. (…) Det är samma grejer var gång också. (Excerpt 5.10, interview with Matthew)*

In common with Matthew, when we discuss Westwillage upper secondary school, Joshua states that *"I do **not** want to go here. (…) I've decided that much"* *("här vill jag **inte** gå. (…) Det har jag*

bestämt mig."). Instead he aims for an upper secondary school in Eastcity. Carin, the teacher, says regarding Westvillage that "*No, it is a little low status here*" *(Nä, men det är lite inte så hög status här)* and:

> Carin: *The weakest students usually end up here in Westvillage, at this upper secondary school. … We have one upper secondary school here as you know.*
> Anna: *Yes, well it seems like, when I interviewed the students and asked them about upper secondary it seems as though "No, I don't want to go here".*
> Carin: *No. (…) But they always say that. (…) But they end up at this upper secondary anyhow. Many other students start maybe at other upper secondary schools and then they don't make it and they come here.*
> Anna: *Ahh, then they come back here, mm.*
> Carin: *But there are those that choose Westvillage in the end because it feels safer.*
>
> Carin: *Dom svagaste eleverna brukar alltid hamna här i West-village på Westvillage-gymnasiet. … Vi har ju ett gymnasium här ju.*
> Anna: *Ja just det för det verkar ju som när jag intervjuade eleverna och frågade om gymnasium så verkade de som att 'Nä jag ska inte gå här'.*
> Carin: *Nä. (…) Men det säger dom jämt. (…) Men dom hamnar där ofta nog ändå. Men även många börjar kanske på andra gymnasieskolor så klarar dom inte av det så kommer dom.*
> Anna: *Ahaa då kommer dom tillbaka hit mm.*
> Carin: *Men det finns dom som till slut väljer också Westvillage för det känns tryggare. (Excerpt 5.11, interview with Carin)*

According to Carin, some students choose Westvillage because it feels safer. Carin says: "*I think Liam could be one of those who choose Westvillage in the end. … I would guess. … And Michael. … And William. … There are quite a few that could choose Westvillage when they finally make up their minds*" *("Det skulle jag kunna tänka mig att Liam skulle kunna vara en sån som väljer Westvillage till slut. … Det skulle jag kunna tänk … Och Michael… Och William. … Det är många som kan välja Westvillage när de väl kryper till korset.")*.

5.3 The classroom and the teacher

If the village and the school's reputations are a little bit shabby, so is the school premises and 8D's classroom that is old and worn. The classroom has eight large desks, each with room for three students. On each side of every desk there is one sink. Compared to other classrooms, these desks are a little bit higher and they are attached to the floor, making it impossible to move the desks. The desks are worn and stained after years of laboratory work and here and there are scribbles on the wood. The large teacher's desk is on a podium in front of the students and the teacher must step up to be able to stand there. When Carin teaches, she sometimes stands behind her elevated desk; sometimes she stands in front it, closer to the students. When standing behind the desk she has the possibility of demonstrating laboratory work. She has her own sink, sockets for electrical equipment and underneath the desk, cabinets. Behind the teacher's desk hangs a large whiteboard where Carin writes the program for the day before or at the beginning of every lesson. Students' work decorates the walls and there are old-fashioned cupboards for all different kinds of laboratory equipment. There is a safety appliance in case of an accident when doing laboratory work; only a fume cupboard is missing. The room is adapted for natural science teaching and learning and the most common subjects to be taught here are physics, biology and chemistry. Carin also teach technology and mathematics here.

Carin, the teacher, is in her early fifties and before she became a teacher she worked as an assistant nurse. In the 1990s she decided to change occupation and she has now worked as a teacher in the natural science subjects (physic, chemistry, and biology), technology, and mathematics for more than ten years. Carin says she likes a profession where she meets people. Carin says that she does not enjoy biology a lot but nonetheless acknowledges that this is the subject most of her students enjoy. She adds that from her perspective, it is common that many students think technology is fun and physics is difficult. Carin states that in contrast to many of her students, she likes physics and technology. I write in my field notes

when they are building model cars that she seems to enjoy this and is proud of what earlier classes and students have made. Carin often plans the teaching and instructions together with another science teacher at school. He and Carin are often engaged in continuing professional development courses and want to improve the science teaching at the school. Together they arrange the yearly Science day at school.

Carin is careful and accurate - for example, keeping books and notes regarding the student's results and achievements. She always plans her lessons beforehand and she is always well prepared with books, hand outs or equipment. During lessons, Carin often moves around, talking with the students. The students are welcome to go behind her desk picking things up, talking with her or looking at something. She is flexible with the students and willing to give them different opportunities to solve things. Liam is one example: she sometimes lets him stay after the lessons have ended so that he can finish his task, even though he was late in arriving or did not behave well. Others that have missed a lesson or forgotten something are given a helping hand, kind reminders, new tasks or a second chance. She has a relaxed relationship towards many students; she has an easy-going dialogue with the students and sometimes jokes with them. Matthew, for example, often jokes with Carin and uses irony when speaking with her. A number of the students say there is nothing unusual about their relationship with Carin and during this unit; she seldom uses an authoritative or angry voice with the students. However, Carin states after one lesson that she is irritated with Lucy and her friend. They have giggled during the lesson. Carin thinks they don't really understand and this is the way they react.

Carin says, several times, that she likes to teach noisy and problematic children. "*I like students like Liam*" *("Jag gillar sådana elever som Liam")* she states. Carin tells me that when Liam (considered to be one of the most problematic students at the school) was threatened to be dismissed during one lesson, he begged to stay and said that he wanted to have the lesson with her. Carin

wants students like Liam *"to make them do something, to make them succeed"* ("*att få dom att göra någonting, att få dom att lyckas*"). *"There is always another person behind all that", ("det finns ju alltid en sådan människa bakom")* Carin concludes. Carin works with a group of students - all considered to be problematic - from different classes. When she talks about one student from this group, she speaks with great empathy and love. At the same time, she admits there is one student in a class that she cannot manage: dealing with her and her problem is too challenging. Carin recognizes that the students' background influences their results and grades:

> *Carin: Sometimes it plays a huge difference and sometimes not. Because, like, if you are persistent and if you are interested, if you are focused on trying to have good results, then I think you will.*
> *Anna: Yes and then it doesn't matter that much.*
> *Carin: It doesn't matter what kind of background you have, I believe. But I think anyway that if you live in a family where the parents maybe are scientists or academics, then I think it is easier because, it is harder to get to the top if you have, if you come from a working-class family, that maybe, but I think that they both have the possibility.*
> *Anna: Both have that possibility, yes.*
> *Carin: Yes, but there is more work to be done for the student that comes from the working-class family than the academics.*
>
> *Carin: Ibland spelar det stor roll och ibland gör det inte det. För att alltså om man är en enträgen elev och man är intresserade om man och fokuserar på att försöka skaffa sig bra resultat så tror jag man gör det.*
> *Anna: Ja och då spelar det mindre roll.*
> *Carin: Det spelar mindre roll vad man har för bakgrund. Tror jag. Fast jag tror ju ändå att om man bor i en familj där föräldrarna är kanske naturvetare och akademiker, så tror jag att man har lättare för det då, det är svårare att ta sig upp om man har, kommer från en arbetarfamilj, som kanske, men jag tror att båda har möjligheten*
> *Anna: Båda har möjligheten ja.*
> *Carin: Ja men det är mer jobb för den som kommer från arbetarfamiljen än akademiker. (Excerpt 5.12, interview with Carin)*

Carin says regarding 8D that *"they are fun to teach, they are fun-nypeople" ("det är roligt att ha dem, dom är roliga personer")*. Carin has several classes at the moment and she compares 8D with 9D and considers 8D a *"weak" ("svag")* class. Carin says that *"I don't do any PWSD work in this group" ("Jag tar inget MVG i denna gruppen")* meaning that she does not teach at a level higher than Pass with distinction. 9D is a positive challenge, according to Carin, and when teaching them "*then I have to go home and read: they often have so advanced questions and then you have to study some more. I don't need to do that here [in class 8D]", ("då får man gå hem och läsa på. Kanske de har så avancerade frågor så man får läsa på. Det behöver man ju inte göra här [i klass 8D]")*. Carin does not give 8D any homework and states regarding the role of homework:

> *Carin: Homework isn't an issue, I think, I usually don't give them any homework, I think they can, in this kind of group, if you give them homework, they just don't do it. There is no rea-son [to give them homework]; they can work when they are here. It just becomes one of those things that you have to follow up. (…) In the other group, 9D, they really want homework.*
> *Anna: So in the better groups*
> *Carin: You can have homework.*
>
> *Carin: Ingen roll tycker jag, jag brukar inte ge dom läxorna, jag tycker dom kan göra, i en sån här klassen om man har läxor så kommer de inte göra läxorna, det finns ingen vits med det, de kan jobba när de här. Det blir en sak som man måste följa upp som inte funkar. (…) I den klassen i nian. De vill gärna ha läx-or.*
> *Anna: Så i de duktigare klasserna*
> *Carin: Så kan man göra det. (Excerpt 5.13, interview with Carin)*

Carin does not believe that any of the students in class 8D will chose a natural science program at upper secondary school. Carin states that Matthew or Nicholas has the ability to make it but she does not think they have enough interest. Nevertheless, Carin wants the students to do their best. For example, when they have a test she encourages them to really try. She pushes Nicholas to stay and write some more. After the test, Carin tells me she has emailed

parents regarding one of the student's results, both good and bad. She is worried about him and has now made contact with his parents. She also tells the student about the email so that he knows. Moreover, Carin is concerned about the girls and she reflects together with me on how she can make the science subjects more interesting for girls and how she can connect the subject with their everyday life.

5.4 Situated on the first floor

Bearing in mind the aims to describe and analyse what ways of acting and talking that are valued or not in the science classroom and how these ways of talking and acting can be related to social class, how is it possible to understand the students and their context? How is this specific science classroom situated in the field of science education (through the concepts field, doxa, and code) - RQ 1? How is this specific science classroom organised in terms of the concepts of classification, framing, instructional and regulative discourses - RQ 2? What is valued and important in this science classroom from the perspectives of habitus, cultural capital, recognition, and realization rules - RQ 3?

Embedded in a socio-historical legacy

8D's science classroom is found on the first floor isolated from other classrooms and behind locked doors. It is built and organized in a way that emphasizes the classification (Bernstein, 1975) towards other subjects such as English or social sciences. Other classrooms in the school are furnished with chairs and desks that can easily be rearranged or adapted to different subjects or pedagogies. This does not hold for technology that is taught as a part of the science subjects. In this school, science subjects, technology and mathematics form a group of integrated subjects (Sjøberg, 1998) that are classified towards other subjects, maintaining the sometimes taken for granted doxa (Bourdieu 1977, 2010) in the Swedish school system that there is a kinship between science, technology and mathematics. Both the classroom itself and the way it is used reflect the socio-historical legacy of science education and sci-

ence education as a prototype of science (Carlone, 2003, 2004). The classroom maintains a strong natural science discourse with the sinks, the elevated teacher's desk and the cupboards with equipment, that facilitate a science education that includes laboratory work (in groups) and (if Carin wished to teach in a more authoritative style) teacher demonstrations. Even though Carin might have other goals and aims, the result might be as Nyström (2009) states that "science teachers often reproduce this discourse in their teaching and communication of the subject although they also try to build positive attitudes towards science" (p. 738). Carin has to "practice teaching within the boundaries defined by very powerful socializing forces" (Engström, 2011, p. 121-122) and is embedded in and has to embody socio-historical legacies.

Carin often moves around in the classroom or places herself in front of her desk when she talks with the students. It sometimes feels like she is not comfortable behind the large elevated desk and that she wants be where the students are. It seems to me that the strongly classified classroom disturbs her aim to establish a weakly classified (Bernstein, 1975) relation to many students. In addition, it disturbs the way Carin organises and carry out her teaching which often changes and needs flexibility to accommodate tasks such as laboratory work, demonstrations, lectures, teamwork or working with hand outs. The students are trapped at their desks and they have to share equipment and sinks.

Unconsciously or not, Carin has to adapt her teaching and pedagogy to the way the classroom is built. Following Bernstein's (1975) argument, the way the classroom is built signals and influences what is a valid transmission of knowledge such as working in teams or listen to an authority. The organization of the premises therefore influences the organization of the pedagogy and since the classroom is strongly influenced by science and becomes a prototype of science, Carin and her students are embedded in its socio-historical legacy and the influences it has on the pedagogy (described in following chapters).

Embodied in a social discourse

Matthew, Joshua and Nicholas say that they do not want to end up in Westvillage. Westvillage is a place for weak students where the weak students can feel secure. The school and Westvillage are surrounded by a kind of discourse that suggests that those who cannot make it elsewhere will end up here in this boring place. If the pedagogy is embedded in and embodies a socio-historical legacy making this classroom a prototype of science, the students are embedded in and embody a social discourse about the village and the school and a discourse that sets students apart. The social discourse presents Westvillage as a safe haven; a haven, however, that constructs one as weak and in need of safety. What this social discourse points to is that it constructs distinctions of its member at the same time as it constructs their members. It is a process where the members in the field construct the area and the school with certain possibilities, options and values while at the same time contributing in adding themselves into this distinction. This is a good value for those - such as Matthew, Joshua and Nicholas - who can leave and make it in the city, while the others - Liam, Michael - might be left behind. In a process that is not attributable to any one of the students, teacher, or society, a social discourse is built, shared and maintained. It is a collective dualistic process that establishes distinctions in the educational system which are acted out in the classroom, in the everyday talk and influence what is valued and not valued.

Embodying hidden negotiations

School and teachers often have good intentions in their teaching and learning. My interpretation is that this is the case with Carin as well. Without the need for calculation or explicit emphasis, Carin's habitus (Bourdieu, 2010) gives her "a sense of how to act and respond in the course of their daily lives" (Mills, 2008a, p. 100). She acts in a very natural and relaxed way in the classroom, quite at home and without a hidden agenda. Rather, she is keen for the students to be able to understand and she tries to be a better teacher, for instance by engaging in further education. She acknowledges that many students think physics is the hardest subject

and reflects on problems and issues to be able to develop her teaching. She wants more students to understand and she reflects on how she can use the students' everyday life as a starting point to help them succeed. Carin states *"I really try, but actually you should start out from the students themselves"* ("*jag försöker ju, man egentligen så ska man ju utgå från mer från eleverna*"). She tries *"to get them to do something to help them succeed"* ("*att få dom att göra någonting att få dom att lyckas*"). Although Carin could be said to have good intentions, at the same time - perhaps due to this good intention - her expectations of the students in 8D are not as high as of class 9D, for example. The lack of challenges such as advanced questions in 8D forces her to remain on a knowledge level below the criteria for PWSD. In a negotiation between expectations from students and society, Carin's intentions and the students' questions, the knowledge threshold is lowered. It could also be described as a deliberation where Carin together with the students maintain an on-going negotiation regarding what ways of acting and talking are valued or not.

Another example of how the often hidden negotiations function is shown in how Carin and 8D deal with homework. Homework could be a burden for students that lack support at home: homework in this situation is reduced to something that only produces a follow-up burden for Carin in the classroom and something that becomes negative for the students. This is probably an attempt from Carin's perspective to avoid a practice that becomes a millstone for the students at home and a problematic situation for her and the students during class. In other classes, such as 9D, she gives homework. Her habitus, her good intentions, and presumptions interact with the classes she has and the students' habitus. The question is if this low expectation of 8D is just an expression of the social discourse that surrounds this group? What if this also creates a knowledge threshold, a lowest common denominator which diverges in relationship to other groups? The result of the hidden negotiations that go on in the classroom might be reduced opportunities for some students who might have gained from homework or teaching on a PWSD-level. The hidden negotiations

changes what is a valid transmission of knowledge for the class and what ways of acting and talking that are valued or not.

Carin seems to feel comfortable both in her role as teacher and in working with the science subjects. She is probably the one most comfortable (Bourdieu and Wacquant, 1992), teaching in subject she likes and in a profession that she enjoys. Despite this, there are some female students that irritate her and one of the problematic girls she feels she can't manage (in contrast with Liam who is constructed by himself and by others as someone with large problems). Carin and some of the girls appear not to be able to play the classroom game together: they cannot co-act and cooperate. They push each other apart in a mutual way, leaving each other out of their games. Laura belongs to the group of giggling, shy and silent girls. She confuses; "*I don't know much about her, really*" Carin says, "but *she is trying*". These processes are not happening with outspoken intention, but rather with hidden and taken for granted presumptions and negotiations. For example, one can question if Carin acknowledges that she repeatedly constructs the boys with higher expectations and that she expresses a different attitude towards boys and girls. According to Bourdieu (2010) for example, there is a risk that these presumptions easily become dispositions that affect the field, since future possibilities and dispositions could be rooted in a student's habitus, which are built up from expectations amongst other things (see Bourdieu (1990) and Reay (2004)). This is something most likely to be expected in this classroom as well (and especially in a subject with its male socio-historical legacy (Danielsson, 2009)). In a hidden negotiative process, the girls are excluded.

Recognising dreams, realising grades

Carin has low expectations of the students in 8D and she does not think any of them will continue into higher education with a focus on natural science. This picture correlates with the students' thoughts. As stated above, building upon Bourdieu (1990) and Reay (2004), this is probably something that could be expected, since future possibilities and dispositions could be rooted in a stu-

dent's habitus, which are in turn built up from expectations. In addition, or in fact due to this, most of the students say that they are not interested in science. It is only Michael who states he wants to continue with science, in his case probably forestry and farming.

Many of the students though have recognised (cf. Bernstein's (2000) recognition rules and realisation rules) that they need good science grades to be able to enter the upper secondary program they aim for. In other words, their answers in the questionnaire and the interview reveal that they study science because they have to, not because they want to. There is nothing that the students in 8D are more in agreement about than that natural science is nothing that the students want to study or want to work with. As Barton and Yang (200) state, "science does not connect with their personal lives (…) and that once they fulfil their scholastic requirements, they will be 'done' with science for the rest of their lives" (p. 876). Seen from this perspective, what they do in the science classroom is realising what they have recognised is sufficient for them. School and grades are not expressed or mentioned when they talk about their dreams; rather, grades are something that are connected to the most expected step after compulsory school.

The students possess "recognition rules to distinguish the specificity of a given context and realization rules to select and produce the appropriate text to that context" (Morais and Miranda, 1996, p. 602). What they think they will do and what they dream about doing are different things. They have recognised that there are dreams and that there is something else. For example, one student does not know what she wants to do when she grows up, but dreams about being an equestrian; Liam thinks he going to be a plumber but dreams of living a good and affluent life. Charlotte dreams of becoming a singer but does not know what she will do after upper secondary school. Joshua is interested in photography but states that it is nothing that he will work with an occupation - he wants a job with a good salary. School and grades are realising means to reach upper secondary school and later on the get a good job, not to achieve their dreams.

A number of student in 8D possess both recognition and realisation rules for the context they belong to. I claim though that what is interesting here is not if you have realisation rules or not, but rather what kind of rules in relation to expected dispositions (habitus) and the classroom practice (and its code), that is interesting. The student must be seen in a context: what is valued and how it is valued there. They and their habitus must be seen in the specific field and what kind of capital that is valued there. The dreams the student expresses are not valued in the field where they belong, nor is somebody actually talking about realising their dreams. Instead they express low self-esteem and show uncertainty and indecisiveness. The students have dreams about their future (artist, equestrian, photographer, football coach) but what they do in school is realising grades so that they can enter upper secondary school which could lead them to get "ordinary" occupations such as child carer, policeman, plumber, working nine to five. It is a future that is expected and expressed by them, and valued in this specific context.

Closed books on the first floor

Getting a good job is one of the dispositions that some students mention. What their parents ascribe them and their future are with few exceptions unclear, the students often saying that they don't know what their parents think. The pictures the students construct of themselves are probably effected by the expectations of their parents or significant others. Matthew is one exception; he talks about his learning processes and what it could lead to, and his parent's importance for his future and his identity. Nicholas knows what his parents expect of him in compulsory school; he is going to be economically rewarded if he gets good grades. However, what many students construct about their lives indicates a lack of discussion in many homes regarding education, occupation, grades, and thoughts about the future. How can this be understood? That the students lack supports from their family? This study does not reveal the answer. However, the way the students talk about their families could be interpreted as though there is little or no communication across the generations and few discussions about school and science. The

perspective on knowledge regarding the family may also be reversed. Bernstein claims that different codes in the classroom could be a "closed book" (Bernstein, 2000, p. 41) for different students due to lack of discussions and help in translating the school in the family. However, is it possible to think the other way around? I claim that it actually is necessary in a dualistic negotiative process. The students do not talk much about their lives and families, and Carin says in the interview that she does not know much about the students' parents. In many aspects and particularly from the point of view of the education system it is the students and their families that are closed books. The question though is why should they talk about their families and their background? Could something else be expected? It is possible that no one other than the researcher has asked them about their future. In addition, the school has traditionally assessed the individual student's talent and attributed success or failure especially when it comes to science - to individual skill. School science as such has not asked for anything else.

Bernstein claims that "the *experience of school* is essentially an experience of the classificatory system and their place in it" (Bernstein, 2000, p. 17, my italics). I claim that there is a need to consider all agents and all perspectives including e.g. their backgrounds, their thoughts and expressed possibilities and the expectations placed on the students. Without a dualistic, negotiative perspective and an understanding of all the agents' disposition and possibilities, there is a risk that the *experience of the students* is essentially an experience of the classificatory system and their place in it. It is the dualistic relationships, the negotiations that actually reproduce distinctions and classificatory systems.

A backdrop has been painted and some examples of what could be found upstage has been described. What has not been in focus and described are different practices in the science classroom and how students and the teacher acts and (inter)play there. The following chapters therefore aim to elucidate this when looking at dialogues in the science classroom and the laboratory works.

6. "ARE YOU WITH ME?"

6.1 Hidden and changing communication patterns

It is Friday at the end of January. It is a dull and cold afternoon, after the lunch break. Last week, class 8D ended a unit on Biology, sexuality and interpersonal relationships. From today and five weeks ahead class 8D will have lessons on mechanics, a part of the course syllabus in physics course. Today's lesson is their first during this unit and Carin gives them their first task; to write what they know about air and motion (luft och rörelse). After ten minutes, Carin calls for their attention and starts to teach. Carin uses overhead transparency pictures and talks about Archimedes, Isaac Newton, and Einstein. She also talks about Archimedes' principle, the force of gravity, Newton's cradle, prism, vacuum and the equation e=mc. The pace is high, not taking more than eight minutes to talk about all the topics. Carin often has a fast pace when teaching; she is also the one who most of the time decides what to talk about and who will speak. Sometimes she asks more than twice as many questions as the students altogether. Many of the dialogues are initiated and organized by Carin, and many dialogues follow more or less a certain pattern denoted by Lemke (1990) as a triadic dialogue. Carin (1) asks, one student to (2) answer and then Carin (3) evaluates the answer.

> Carin: And then you said something about Archimedes' principle. What was that? (Teacher question)
> Liam: Yes, him.
> Carin: Raise your hand, Liam.

Nicholas: The thing with the bath. (Students answer)
Joshua: Yes, when he sits in the bathtub.
Carin: Yes, the thing with the bathtub, yes. (Teacher evaluation).

Carin: Och sen sa ni nånting om Arkimedes princip. Vad var det för någonting?
Liam: Jaa han.
Carin: Räck upp Liam
Nicholas: Det där med badet.
Joshua: Ja, när han satt i badkaret.
Carin: Det där med badkaret ja. (Excerpt 6.1, audio recording, lesson 2010-01-29)

Another way of talking, another form of communication pattern could be observed the following Friday afternoon. Carin stands behind her desk ready to teach the students about scientific concepts and phenomena through demonstrations. The students are excited: Carin has many things on her desk that they have not seen or used before. Conner and some other students call out loudly what they think: *"Cool! Can I buy it from you?","Can I take a picture?", "Have you bought it on e-bay?" ("Coolt, får jag köpa den av dig?", "Kan ta en bild?", "Har du köpt den på e-bay?").* However, when Carin starts to teach the students are hardly involved in the dialogues. Carin uses longer sentences than the students, the students' utterances are shorter and most of them are answers to questions. Carin asks many questions, however not using the same communication patterns that were seen earlier where the students had options to show they wanted to answer by for example raising their hands. Instead she addresses a number of students more straightforwardly and puts direct question to them (marked in bold):

Carin: **What does James say?**
Matthew: But it depends on [inaudible]
James: Well, I don't say anything.
Carin: Yes, **but what do you think?**
Liam: The one that you let go will come first.
Carin: They will come at the same time. The one that you let go will come first, says Liam. **What do you think Michael?**

> *Carin:* **Vad säger James?**
> *Matthew: Men det beror ju ändå… (ohörbart).*
> *James: Nä, jag säger ingenting.*
> *Carin:* **Ja men vad tror du?**
> *Liam: Den som du släpper kommer först.*
> *Carin: De kommer lika. Den som man släpper kommer först säger Liam.* **Vad tror du Michael?** *(Excerpt 6.2, audio recording, lesson 2010-02-05)*

After a couple of minutes she continues with the same way of putting direct questions, asking for example "*And that is, Benjamin? What is that?" "Are you with me? Ahm, Danielle will do a calculation on something with the weight five kilos!" ("Och det blir Benjamin? Vad blir det?""Är ni med? Ähm. Danielle ska räkna ut på någonting som väger fem kilo").* Carin is the one who talks the most during this episode and she has decided the scientific content. In addition, she initiates the dialogues and specifically selects who will speak. When Carin explicitly puts direct questions, other students become visible, students seldom heard in the classroom dialogue. On the following Monday, similar forms of dialogues can be observed. Two of the silent girls, Lucy and a friend at her desk who seldom have a voice in the classroom, have the opportunity when they are asked to read out loud the instructions for a laboratory experiment. The same way of talking could be observed on other lessons when Carin explicitly asks certain students: "*Can you answer this James?" "How many newtons is that? Can you answer this Amy?" ("Kan James det?" "Hur många newton är det? Kan Amy det?").* Other students such as Lucy (instead of Joshua, Matthew and Nicholas) are heard when Carin changes her way of talking in the classroom and addresses certain students more directly. Referring back to the research question and the theoretical frameworks - how can this be understood?

Complex communication or complex content?

One of the most important aims of education is the transmission of knowledge, explicitly directed by curricula and syllabuses. One way to transmit knowledge is through communication and spoken dialogues and this is an important feature of science (see chapter 3). Communication is a means to transmit a certain scientific con-

tent, often constructed as complex and difficult (see chapter 3). The communication and the science dialogues in this classroom show another form of complexity though, less concerned with the scientific content and concepts than with the form and character of the communication. Criteria, content and goals for the science content are explicit and expected. What characterizes many dialogues is that there are certain communication patterns to follow such as the triadic dialogue (Lemke, 1990), the strongly framed dialogues (Bernstein, 1975) and, as we will see, in the sounding board dialogues. The dialogues in 8Ds classroom put forward certain content; they also put forward a way of talking. There is an instructional discourse (transmission of skills) and a regulative discourse (transmission of manner, character and conduct) (Bernstein, 2000). The latter is never explicit or reflected upon during this unit. However, the analysis shows that this is decisive when looking at who is given and who takes the dialogical room to manoeuvre. For example, certain students become visible in the strongly framed dialogues and in the triadic dialogues.

Communication in this science classroom could be seen through these two discourses, the regulative and the instructional discourse. However, communication in this classroom does not only have these two discourses to regard; in addition, Carin often changes the ways she talks. She changes the way the communication is framed, strongly or weakly, and as a result changes what kind of communication that is valued in different situations. For example, in certain dialogues you are expected to raise your hand, showing that you want to be asked, in others you are expected to answer certain direct questions. Consequently, the students need to adapt and interpret to changing ways of talking (Mehan, 1979). This implies that in the science dialogues, the students not only need to translate and understand two different discourses. They also need to recognise and adapt to the changing pedagogy. It is like a script with alternate acts written and performed simultaneously in two languages. Being able to translate, interpret and adapt to new or changed situations means greater possibilities of understanding what ways of talking and acting that are valid or not, and when. Matthew and

Nicholas are two students that usually quickly adapt to the changing communication patterns in the classroom. Other illustrative examples can be found considering the following the sounding boards described below.

6.2 Sounding boards

Returning to the very first lesson, the Archimedes-episode where Carin rapidly demonstrates some scientific concepts and phenomenon, Carin uses communication patterns that organize the way students talk, what they talk about and the pace. However, after a while she changes the way she talks with the students. She starts to ask for the students' opinions, giving more room for their opinions by asking them "*Are you with me? What shall we write as a conclusion? Now, it's time for central motion. Or haven't you finished yet? Can I erase this?", ("Är ni med? Vad ska vi skriva som sammanfattning? Nu tar vi centralrörelse. Eller ni har inte skrivit ännu kanske? Kan jag sudda?").* Carin opens up for students to be a part of the dialogues more than in the dialogues described earlier. In these dialogues some students insert short answers, confirmations or short sentences when Carin speaks. They do that without being asked or raising their hands. Some students function as sounding boards or as prompters to Carin. Joshua is one of them (marked in bold):

> Carin: I will bring one of these cradles to you later on [inaudible].
> **Joshua: Will it ever stop?**
> Carin: If it not had been for, it stops because there is friction in the air. But if it had been in vacuum it would keep going forever.
> **Joshua: Vacuum?**
> Carin: Vacuum is when you have removed all the air.
> **Joshua: Well, Ok.**

> Carin: Ja ska ta in en sån vagga för er sen så ni (ohörbart).
> **Joshua: Kan den aldrig stanna?**
> Carin: Om det inte hade funnits, den stannar för att det finns friktion i luften. Men om den hade varit i vakuum så hade den gått i evighet.

Joshua: Vakuum?
Carin: Vakuum är när man tagit bort all luft.
Joshua: Jaha. *(Excerpt 6.3, audio recording, lesson 2010-01-29)*

Joshua and in addition Nicholas and Matthew are students that often insert short answers, confirmations or short sentences when the teacher speaks. They do that without being asked or raising their hands. Neither the teacher nor the students become irritated and they are not corrected. Strictly speaking, they are breaking the rules that you should not talk out loud without being asked or having raised your hand; however they are seldom reprimanded. They seem not to disturb the order but rather appear to be an ordinary part of the classroom dialogue. Sometimes they even carry the scientific dialogue forward.

Joshua's dialogue with the teacher above shows how he helps to bring forward the notions of vacuum and friction, important scientific concepts in this unit. Moreover, he is functioning as a sounding board for his classmates, in this case Nicholas. Also pay attention to Liam in this excerpt:

Carin: And then you said something about Archimedes' principle. What was that?
Liam: Yes, him.
Carin: Raise your hand, Liam.
Nicholas: The thing with the bath.
Joshua: Yes, when he sits in the bathtub.
Carin: Yes, the thing with the bathtub, yes.

Carin: Och sen sa ni nånting om Arkimedes princip. Vad var det för någonting?
Liam: Jaa han
Carin: Räck upp Liam.
Nicholas: Det där med badet.
Joshua: Ja, när han satt i badkaret.
Carin: Det där med badkaret ja. (Excerpt 6.4, audio recording, lesson 2010-01-29)

And sometimes the sounding board helps to maintain order:

> *Carin: But Matthew, can you keep quiet, you're irritating to-*
> *day.*
> *Joshua: Matthew, you're excited as a little beaver. Quiet!*
> *Matthew: Ahhh!*

> *Carin: Men Matthew kan du hålla tyst, du är störig idag.*
> *Joshua: Matthew, du är uppspelt som en liten bäver. Tyst!*
> *Matthew: Ahhh. (Excerpt 6.5, audio recordings, lesson 2010-*
> *02-17)*

The week after that, when Carin shows some exciting demonstrations, Joshua, Matthew and in addition Liam, take on the roles of sounding boards, talking straight out into the classroom, inserting short comments or answers (marked in bold):

> *Carin: Ahm, how can the coca cola can stand up like this?*
> **Liam: Magnets.**
> **Joshua: Water in it.**

> *Carin: Ähm, hur kan cokaburken stå så?*
> **Liam: Magneter.**
> **Joshua: Vatten i den.**

> *Carin: Are you with me? Did you hear? Was it at the same time*
> *or was it different?*
> **Liam: At the same time.**
> *Carin: Should I do it once more?*
> **Liam: Yes.**
> **Matthew: I thought it would go a long way.**

> *Carin: Är ni med? Hörde ni det? Var det samtidigt eller vad det*
> *olika?*
> **Liam: Samtidigt.**
> *Carin: Ska jag göra det en gång till?*
> **Liam: Ja.**
> **Matthew: Jag trodde den skulle gå långt.** *(Excerpt 6.6, audio*
> *recording, lesson 2010-02-05)*

It is a fine line if you are allowed and if you are given room to manoeuvre to act as sounding boards. For example, Liam was not allowed to talk straight out in one dialogue described above, but this

time it is ok. When Matthew, Joshua and Nicholas, who usually work as sounding boards, are away helping out in the cafeteria Connor takes on this role (together with Liam) and more than in earlier episodes works as a sounding board.

Joshua in the prompt box

In weakly framed dialogues some student can function as sounding boards or as prompters to the teacher as well as their classmates. The communication patterns that the sounding boards use are often hidden or taken for granted activities or discourses. It is the rules of a game that are not explicit and probably used unconsciously by both students and teachers. Strictly speaking, they do not follow the script, breaking the rules on the stage. Nevertheless, they are legitimized by the rest of the group and the teacher that can use these students in bringing forward a discussion from the content. Everybody in the classroom appears to feels comfortable with it; nobody objects to the way the prompters talk. The sounding boards or the prompter is also an important part of the play. When Matthew, Joshua and Nicholas, who usually functions as sounding boards, are away, Connor takes this role (together with Liam) and more than earlier episodes works as a sounding board and keeps the game going. The classroom needs the sounding boards and the classroom legitimizes them.

It is as if the sounding boards know instinctively what they are expected to do, how and when, without interfering. The sounding boards have a feeling for the game; they are quite at home in the situation (Bourdieu and Wacquant, 1992). They help to conduct the scientific content, they sometimes maintain order, they know how to play the game and they know what they are expected to do and what they are able to do. They do this without interfering with the lesson, getting on the wrong side of the teacher or the other students. This entails for example getting involved in control of the selection (Bernstein, 2000) and also entails better chances to be fairly evaluated. In addition they are given and take the opportunity to be a part of the argumentation and reasoning in the science classroom, given greater possibilities to express themselves in a

more complex way, sometimes using a vertical discourse (Bernstein 2000).

Joshua is one of the students that often sits in the prompter box. In some classroom situations, Joshua is insecure (such as in group work). When talking with Carin about Joshua, she says that "*he is very polite and nice and works well during lesson and talks during lessons but when he writes a test or something he doesn't get good results, so I don't really know about him*" ("*Han är ju väldigt artig och trevlig och jobbar bra på lektioner och pratar på lektioner men när han gör något prov eller så så har han inte så bra resultat så det vet jag inte riktigt med honom*"). However, there are many situations in the science classroom where Joshua seems to feel comfortable, such as in the dialogues with the teacher. When he can function as a prompter from his place in the second row straight in front of the teacher, he is given and takes spielraum (Roth and Tobin, 2001). He is comfortable in this position (Bourdieu and Wacquant, 1992) and works as a prompter for the teacher as well as for other students (Matthew and Nicholas) and helps to establish and maintain an instructional as well as a regulative discourse. This are situations where he feels comfortable, something that is emphasised in the interview when he states that if he were the teacher he would "*focus on telling and stuff like that*", ("*fokusera mer på att berätta och sånt*"), this is the method of teaching that he would have chosen if he were the teacher. When the teacher focuses on talking, Joshua can be a player in the game and can recognize what is needed and realize with appropriate actions: listening, answering, doing tasks, raising hands, asking the right question in the right moment (cf. Bernstein, 2000). Where does this familiarity come from? We can only speculate, but Joshua expresses a belief in authorities, such as the teacher or his father. This becomes manifested in teaching activities where his habitus can be brought to life and he can behave in a certain way, valued in this situation where he can listen to the teacher (c.f. Bourdieu, 1990) and follow this hidden communication pattern. In other words, the effect of habitus is that he owns recognition and realization rules

for these kind of activities and instantly knows how to talk and what kind of talk is valued.

The sounding boards operate in several ways "below the level of calculation and consciousness, underlying and conditioning and orienting practices by providing individuals with a sense of how to act and respond in the course of their daily lives" (Mills, 2008a, p. 100). This could have different implications. Joshua's way of talking in the classroom, gives him advantages such as being heard and fairly evaluated. What he values, or what he thinks is valued, what he has been brought up to value, are in coherence with the values put forward in school and the school science field. This is rewarded in school by the teacher and the students who let him be a part of and influence the dialogues even though it breaks the rules. Friends (foremost Nicholas and Matthew) with similar interests, upbringing and social status reward Joshua's abilities.

Joshua is also an example of the hidden negotiation process. When helping the teacher to maintain the regulative discourse (and sometimes the instructional discourse), he both influences and is influenced by the pedagogy. Mutually, they construct what ways of talking that are valued and how you can act and talk in a hidden deliberation or negotiation. The weakly framed dialogues are like other situations continuously under negotiation and not something that Carin decides for herself. Rather, it is permeable process between all the actors in the field; it is a collective process (Bourdieu, 1990).

At first sight, the weakly framed dialogues show possibilities and options; however it gives freedom only for a few students (foremost Joshua, Matthew and Nicholas). This chimera and the effects of the hidden negotiation are shown explicitly when looking more closely at Lucy and her friends.

6.3 "But the girls, I need to give them tests or else I don't know"

It is Monday morning, Carin goes through the test they had last week. The students have received their tests and now Carin wants to go through it to ensure that everybody understands. Lucy and her friends are talking to each other at their desk when Carin asks them about one question:

> *Carin: Then we come to inertia:, Lucy and Emily what does it mean? Did you know the answer?*
> *Lucy and Emily: Yes.*
> *Carin: Do you know?*
> *Lucy and Emily: (silence)*
>
> *Carin: Då står det tröghet, Lucy and Emily vad betyder det? Kunde ni det?*
> *Lucy and Emily: Ja.*
> *Carin: Kan ni det?*
> *Lucy and Emily: (tystnad) (Excerpt 6.7, audio recording, lesson 2012-02-15)*

The classroom is seldom completely quiet but now it is just that; everybody is waiting for their answer. But the answer never comes and instead another student answers the question.

There are almost never any girls heard in many of the dialogues in the classroom, whatever the communication pattern. The girls are only to be heard when Carin asks them direct questions. They are more or less invisible and over and over again I write in the field notes that the girls are silent in the classroom. Neither do they seek to have a voice. For example, when Carin carry out a teacher-controlled laboratory experiment at her desk she says *"Then I need two volunteers!"* (*"Då behöver jag två frivilliga"*). Finally it is Liam who volunteers and then Carin asks another student. The girls never volunteer.

In the middle of the unit, Carin hands out the results of oral and written performance so far and she wants the students' own com-

ments on her grading and also to write their own expectations regarding grades. Lucy and her friends discuss the hand-outs with Matthew who sits in front of them:

> Matthew: Molly, you know what that is, oral activity?
> Molly: When you talk and stuff.
> Matthew: Did you get minus?
> Lucy: I got that too.
> Laura: What did you got Molly?
> Molly: You got it too, right?
> Lucy: Yes.
> Molly: Is that when you put up your hand and stuff?
> Lucy: Mm (inaudible).
> Amy: What did you get Laura?
> Laura: Minus. (…)
> Lucy: Laura doesn't talk. Do you talk?
> Amy: No.
>
> Matthew: Molly, vet du vad det är, muntlig aktivitet?
> Molly: Man pratar och så.
> Matthew: Fick du minus?
> Lucy: Det fick jag med.
> Laura: Vad fick du Molly?
> Molly: Det fick du med va?
> Lucy: Ja.
> Molly: Är det när man räcker upp och sånt
> Lucy: Mm (ohörbart).
> Amy: Vad fick du Laura?
> Laura: Minus. (…).
> Lucy: Laura pratar inte. Pratar du?
> Amy: Nej. (Excerpt 6.8, audio recordings, lesson 2012-03-01)

According to their dialogue, they have some idea what you should do and what is needed in the dialogues; ("*You talk and stuff." "Is that when you raise your hand and stuff?*" ("*Man pratar och så." "Är det när man räcker upp och sånt?"*)). Still, they are silent most of the time in the classroom dialogues. In group assignments the girls talk with each other or discuss with the teacher without being shy. These dialogues consist of descriptions of the laboratory work, questions and discussions. Nevertheless, in the large classroom dialogue, their descriptions, opinions and arguments are never heard. Instead, Carin says: "*But the girls, I need to give them tests or else I*

don't know". She feels she is forced to use the test to try to figure out what the girls actually know.

Lucy in the spotlight

Sometimes Carin uses strongly framed (Bernstein, 1975) dialogues and puts direct questions. The students can await their turn and decide to be a part of the dialogue (or not) when the questions come. Students like Lucy and some of her friends can be heard in these situations. If Carin and the boys control the classroom dialogue, often in hidden discursive practices such as triadic dialogue (Lemke, 1990) and the sounding board dialogues, the girls are only to be heard in the strongly framed, controlled dialogues when Carin asks them direct questions. However, in the strongly framed dialogues it becomes apparent that many of the girls do not want be in the spotlight or want to volunteer. When Lucy and her friend are placed in the spotlight, a place where they appear to feel uncomfortable, they become shy and silent. Lucy's habitus (c.f. Bourdieu, 2000), is shown in the situation where she does not feel at home and with that follows "vagueness and indeterminacy" (Bourdieu, 1990, p. 77).

Instead of an opportunity to show what they know and be a part of the classroom, the above dialogue - where Lucy and her friend do not answer - becomes more of a disciplinary dialogue which demarks and excludes them. During the unit, Lucy resists being a part of the classroom dialogue on at least one more occasion and she never volunteers to be in the spotlight. When the girls' voices are never heard in the large classroom dialogue, their descriptions, opinions and arguments are never heard. In addition, they have not the same chances to take control or be a part of planning, nor to be fairly evaluated, entailing fewer chances of success in this school science classroom. Instead of an opportunity to show what they know, Carin is forced to use tests. I assume that from the best of intentions, Carin wants to evaluate and assess them correctly and accurately: Carin feels she has to change her pedagogy to adapt to the girls and to curricular demands. It is therefore not only the girls

who need to interpret, translate and adapt. Carin needs to do the very same thing.

Lucy and her friends have some recognition rules (Bernstein, 2000) regarding what is asked for and expected of them in the classroom dialogues. According to Molly, the minus they receive on the evaluation hand-out is something they expected (*You got it too, right?)* and they appear not to be disappointed or surprised. The girls have an on-going very internal, closed conversation where they talk and act in a similar way. Lucy and her friends have settled their own way of talking. In this group, they are not putting value into being a part of the classroom dialogue even though they actually seem to have recognition rules for it. In this particular case, this is underscored by their backgrounds that are similar. In addition, they seem to have similar thoughts and expectations regarding, for example, school and grades. In many aspects they could be said to belong to the same social class when sharing both similar socioeconomic backgrounds, features (such as ways of acting and talking), and in addition, expectations. This is also emphasised by their joint place on the hierarchy scale, where they are not seen as individual people but "the girls": sometimes their names are even mixed-up.

Lucy and the others in her group bring into their little circle similar cultural capital (Bourdieu and Passeron, 1977) that they can exchange in their group but not in the large classroom dialogues or with others in the classroom. The girls share the same habitus, they share "a system of dispositions common to all products of the same conditionings" (Bourdieu, 1990, p. 59). Similarly, "the effect of the habitus is that agents who are equipped with it will behave in a certain way in certain circumstances" (Bourdieu, 1990, p. 77) which the girls display in the way they talk and act. The effect of the girls' similar social class is that Lucy and her group acts like players in their own game. It is not the same game as the classroom code acts within (Bernstein, 2000, Bourdieu, 2010). The consequences are that Carin is "a little bit uncertain" about the girls or that Carin's interpretation of Lucy is that she actually "does not

understand". Sharing the same habitus could add value inside the group; however from the outside, it devalues their possibilities and the expectations others have of them.

What Lucy brings into the classroom is her membership of a group from a similar social class that supports certain ways of acting and talking. This is happening even though, according to Lemke (1990), the failures is the result of their membership in a social group (such as social class) not currently being rewarded. Into this relationship and the classroom Lucy adds (or is positioned with?) low self-esteem, low expectations and no interest in science. In the end, Lucy barely makes it and receives a pass in all subjects. As Arnot and Reay (2004) state, control over the pedagogical practices was shaped by the social relations of the classroom. In an intricate interplay, with hidden negotiations between the practices in the classroom, the teacher and her expectations of the group, Lucy's low interest in science and the effects of her membership in the group with its social class, Lucy as a student elucidates what ways of talking that are or are not valued and how these ways of talking in this science classroom can be related to social class.

Even though Lucy shows resistance to the strongly framed dialogues, many students that are never heard get a voice or are obliged to follow the teacher's expectations and talk. Both content and communication patterns are explicit in the strongly framed dialogues. This form of dialogue lacks a hidden way to talk, it is obvious what to do and who will do it: "*Molly can you read it?*" "*What does James say?*" "*Jack will calculate something that weigh*" (*"Molly kan du läsa det?" "Vad säger James? "Jack ska räkna ut någonting som väger").* With an explicit dialogue, Carin makes room for other students than those heard in communication patterns where what pattern to follow is not clearly directed. At first sight, strongly framed dialogues could therefore be seen as something positive for silent or students not able to follow the hidden patterns. On the other hand, these forms of very strongly controlled dialogues are based on a simple form of argumentation and from one point of view (foremost the teacher). Even though Carin

gives the silent students a chance to let their voices be heard and evaluated, the argumentation and the complexity of the dialogues and the scientific knowledge are narrowed. The answers are short and non-complex such as *"No", "Two" or "Twenty-five"*.

Nylund and Rosvall (2011) state that vertical discourses in the classroom give power and have potential to question existing circumstances since they give the possibility and access to think outside the context, outside the box. However, in this classroom, horizontal discourse is used more frequently and especially for those that might need access to think outside their context. Despite this they are not given a fair chance to argue, develop or show a deeper and more complex argumentation which is needed to reach higher grades in the Swedish school system (see chapter 3). Since some students always and only meet everyday knowledge in school (which does not give the further possibilities that vertical discourse gives) they are not given access to the discourses that would have given them possibilities to break the uneven distribution of knowledge and power in the education system and society. It becomes a dialogue and a discourse based on the lowest common denominator that in the long term excludes students. In this case, this concerns foremost the students that come from another social class than the successful (in terms of grades) students.

However, what is seen in the classroom is that it is not only the students from a certain social class that are excluded. All the students in the classroom are suffering under this discourse since Carin negotiates and adapts her pedagogy and expectations to the group: *"in this group I don't use any PWSD methods", "but the girls, I need to do test or else I don't know"*. Therefore, I claim it is not only interesting to describe how the production of advantage and disadvantage are reproduced and what the consequences (c.f. Bernstein, 1990 Sadovnik, 1991; Hallstedt and Högström, 2005) are for different groups of students, but for all the students in the context. I agree with Nylund and Rosvall that forms of knowledge could be linked to what kind of possibilities and limitations students are given. However, these perspectives must be broadened,

and there must be a deeper focus on the effects this exerts on all students in the classroom. Transmission of knowledge and its consequences must be seen as a collective process that concerns all students.

6.4 Questioning "Are you with me?"

What is shown is that the science dialogues are not simple communications from one party to another, neither that what is difficult in the science dialogues is the content. It is rather a game in which the students (and other actors) need to understand and engage in the translation and interpretation of (at least) two discourses, an instructional and a regulative. It is through these processes that students like Joshua and Nicholas become successful in this science classroom. Lemke (1990 states that "they may learn how to play the classroom game but they won't learn how to talk physics or biology" (p. 11). Students need to understand both discourses. One example is Matthew who is a part of the classroom game and interprets and influences the regulative discourse. Nevertheless, in the end his grade is mediocre and he never learnt to talk physics as expected in this classroom. Lucy is not a part of the regulative discourse and consequently the teacher knows nothing about her instructional discourse. This is also shown with other students in the classroom who do not have recognition and realisation rules for what is going on in the science dialogues: in the cases of Matthew and Lucy, it becomes hard to evaluate their scientific knowledge.

Zevenbergen (2005) claims that the student's family has shaped the student's language, which entails that some students enter school with familiarity with the language that is spoken in for example the mathematics classroom. She argues that if the students enter the classroom with greater linguistic experience they will have better chances to understand the language that the teacher uses. This is not something that is clearly shown in this study. Zevenbergen does take into account that there can be two different discourses operating. Seen from the analysis in this study, I claim that the science dialogues must be understood with several dictionaries. Nev-

ertheless, following Zevenbergen's argumentation, there are some students (Matthew, Nicholas and Joshua for example) that are ascribed as good learners; they have similar background, share many interests with regard to school and grades, and also their spare time. They could be seen to be from similar social class. With their manners and ways of talking, possibilities of understanding codes and hidden everyday practices, they bring with them a feel for the game that they can take advantage of. They could be said to bring into these specific situations a habitus that can be transformed into cultural capital (here: ways of talking) which gives them advantages. However, it is not their background itself that gives familiarity and in turn advantages: it is in the particular practice and in interplay between the dialogues and the students that this becomes visible. This correlates with some of the findings Zevenbergen made in her study where she concludes that "through the practices within the field, ability-grouping constructs a habitus that either includes or excludes students from the subject" (p. 617) and there was an "overwhelming emphasis on the experiences of the ability grouping and the impact that these experiences had on the students' relationship with school mathematics" (p. 608).

It is in the effect of the student's ways of talking and acting when meeting a certain form of communication pattern in a specific situation that social class in the science classroom can be understood and described - through the practices within the field and the students' experiences of this. Kraaykamp argues that "the narrative account of the mechanism holds that children with more cultural capital communicate more easily with teachers; … and, in general, do not experience a school's cultural climate as hostile" (Kraaykamp, 2000, p. 96). Yes, that may be the outcome, but what causes this could not be explained with cultural capital only, it has to been seen in the processes in specific fields in and in the effects of relationships.

Lucy and her friends are students who in many respects could be said share social class due to socioeconomic background and social status, for example. Their chances in the classroom are narrowed,

looking at the way they accept or refuse the room to manoeuvre that is offered in the dialogues. Nevertheless, the correlation between social class and "success" is neither deterministic, nor clear and there are students that break the pattern. Liam is the exception that proves the rule in this classroom. He does not care about the regulative discourse, however manages some of the instructional discourse. He creates room to manoeuvre in the classroom by sometimes staying late, working at his own pace by himself. In Lucy's case, it is the membership in a specific social class-group and the effect it exerts on its members that is relevant (cf. Bourdieu (2010) discussion regarding social class). Wanting to be a part of the group where certain cultural capital is valued influences her way of acting. There is a relationship between social class and the science classroom but it is complex and dualistic.

This chapter started by describing hidden and changing forms of communication (strongly and weakly framed dialogues, regulative and instructional discourses) where there were demands for translation and interpretation in order to be able to get good grades. To understand and interpret the regulative discourse, (that overrides the instructional discourse (Bernstein, 2000)) is crucial. In other words, ways of talking are more important than what is talked about. Students that can interpret and (want to and are given the chance to) show that they can interpret and follow this regulative discourse have clear advantages in reaching higher grades. For example, those who have taken the chance to participate in a kind of argumentative and reasoning communication have better chances of reaching higher grades in the Swedish education field. One way to achieve this is, as Mehan states, to "engage in interpretive work to analyze the flow of interaction and provide the appropriate behavior. … To participate in lessons, students must pick up the subtle cues that signal the applicability of a given procedure on a particular occasion of interaction" (p. 124-125). This is true in this classroom as well; however what has also been seen in the dialogues is an on-going interpretive, conciliation process from all the actors. What becomes valid transmission of knowledge is therefore not only up to Carin and her pedagogy, neither is it a question of

each student's specific socioeconomic background. This is shown, for example, by Joshua who functions as co-director with Carin or with Lucy and her friends who resist or remain quiet, forcing Carin to change her assessment procedures and use tests to be able to evaluate them. Mehan (1979) claims that the students "must learn the appropriate form in which to cast their academic knowledge. … They must know with whom, when, and where they can speak and act, and they must provide the speech and behavior that are appropriate for a given classroom situation" (p. 133). However, it is not only the students that need to engage, participate or to pick up cues. It is a continuing hidden negotiation, a permeable, interpretative dualistic process. As much as Carin asks the students "*Are you with me?*" in their communication, the students ask their friends and Carin the very same thing.

7. "IT'S A PITY YOU GOT ME"

7.1 Characterizing laboratory work

It is Wednesday before lunch and today the class is supposed to plan the laboratory experiment they will carry out tomorrow. Carin starts to give instructions about the laboratory experiment; she shows the equipment and writes on the whiteboard. Carin and the class talk through two matrixes with the assessment criteria and the laboratory experiment criteria. The matrixes are filled with criteria and goals on different levels and are supposed to help when the students plan their work and write their report. The students start to plan their laboratory experiment without the teacher, mostly in their groups. During the lesson, the students have many options to pay attention to and many decide to continue to work in their groups. After approximately thirty minutes the lesson ends and the students go on to their next lesson. The following morning when the students arrive for their lesson, Carin has written on the white board:

> *Carry out the laboratory work – together, write the laboratory report – separate. For help when writing the conclusion, page 76, 77, yellow physics book.*
>
> *Genomför laboration – gemensamt, Skriv laborationsrapport – enskilt, Tips till slutsatsen sidan 76,77 gul fysikboken.) (Field notes 2010-02-04)*

The students are not provided with any further information and start to work from where they ended yesterday, carrying out their

laboratory experiments at their desks. Today as well the students are given many options. For example, when writing the report, they can choose between using a template and writing from scratch by themselves. This decides what kind of grade that is possible to receive. The possibility of reaching a higher grade is restricted to those students who write the report from scratch by themselves, while using a template entails a Pass grade at best,

In the following weeks, similar procedures, working mostly by themselves, often in groups, and with many options, could be seen. For example, in the middle of the unit, Carin taught 8D about the dynamometer and motion. When she has finished talking, Carin gives them fifteen minutes to work by themselves with the laboratory work. Another week, during a laboratory experiment on an inclined plane, Carin states that she wants them to carry out the laboratory work by themselves and that it should be seen as a test in setting up an inclined plane. Carin gives them some instructions and states:

> *This lab work is quite difficult but I want you to try as hard as you can, ask me for help only in case of emergency., I want you to manage as much as possible yourself. There are long rulers down there. While you start to set up, I'll go and get the weights. Don't ask me too many questions.*
>
> *Denna laboration är ganska svår men jag vill ni försöker så mycket ni kan, bara i nödfall frågar ni mig om hjälp, jag vill att ni klarar så mycket som möjligt själv. Annars finns det långa linjaler därnere. Medan ni monterar så hämtar jag vikter. Fråga inte mig så mycket. (Excerpt 7.1, audio recording, lesson 2012-02-12)*

Every so often the students start to work, making their plans and doing their experiments in their groups as they usually do. This way of dealing with laboratory work continues into the next unit when the class is building model cars. They are given a hand-out with instructions which are explained by Carin. From then on and two weeks ahead, Carin works more like a supervisor in the class-

room. How to carry out or plan the work is more or less up to the students or as will be shown, groups of students.

The laboratory work in this classroom could be characterized by a number of things: firstly, it is a very common way to work. During this unit on mechanics, class 8D had five different laboratory sessions. There were for example laboratory experiments on free fall (fritt fall), leverage (hävstångsprincipen), friction (friktion), and the inclined plane (sluttande plan). The laboratory work permeates the teaching throughout the unit; beforehand they plan their laboratory work, afterwards Carin talks through the experiment with the students, and sometimes they write reports.

Secondly, the laboratory work in 8D during this semester is characterised by the many decisions that are left to the students and the students having many options to take into account during the lessons. This is somewhat contradictory though, since the laboratory work is the only activity in the classroom during this unit that has its own matrix. The matrix describes criteria: what is expected to be a part of the experiment and how to write the report. However many decisions are left to the students, such as which level to aim at achieving, how to perform the laboratory work, how long each different laboratory steps (set ups, etc.) should take.

Thirdly, laboratory work takes place in groups, in teams. The students often work together with their friends at their desks and this is emphasised several times. Working in teams, or in the pairs in which you are seated is sometimes explicitly outspoken, but during a number of episodes it is just something that the students do. Working together in groups or pairs where you are seated is also emphasised by the way the classroom is arranged with the stationary desks. For example, there is one sink at each desk; the students have to share laboratory equipment.

Finally, working together in groups is not only considered to be important by Carin, it is also commended as a good way to work and learn. For example, Carin suggested in discussion with Joshua

that; *"when you help others, you become a lot better yourself"* *("när man hjälper andra så blir man jättemycket bättre!").* During one lesson when Carin is away this is implicitly underscored by a substitute teacher. The substitute teacher nags at Lucy, Laura and their friend to start work. It turns out they don't know what to do. The substitute teacher (ST) has a solution:

> ST: Let's all help out. Turn around into the right direction.
> Lucy: Why?
> ST: So that you can help Laura, so you finish this task.
>
> *ST: Då får vi hjälpas åt. Vänd er på rätt håll.*
> *Lucy: Varför då?*
> *ST: Så att ni kan hjälpa Laura, så ni får gjort den här uppgiften.*
> *(Excerpt 7.2 audio recording, lesson 2012-02-18)*

The laboratory work in this classroom could be characterized as a common and important activity that most often takes place in groups and often leaves many options for the students. This is the way it could be characterized: however, what is happening in the groups and what is heard when listening more closely to the students and the dialogues?

"I don't get it"

Going back to that Wednesday lesson when the students plan their laboratory work; Carin starts to teach, she shows equipment and writes on the whiteboard. While Carin continues to teach, the students start to talk with each other in their groups, many of them have problems understanding what is going on saying "*I don't get what we should do. Hello! What should we do? I don't get it*". "*What kind of experiment should we do?*" (*"Jag fattar inte vad vi ska göra. Hallå! Vad ska vi göra? Jag fattar inte." "Vad är det för laboration vi ska göra?*"). At the same time at another desk a student asks "*What kind of experiment should we do?*" (*"Vad är det för laboration vi ska göra?"*) while somebody answers "*I have no idea*" (*"Jag har ingen aning"*). Another student asks straight out in the classroom "*What is friction?*" (*"Vad är friktion?"*). "*If you wait a second I will tell you*" (*"Om ni väntar lite så ska jag gå igenom det"*) Carin replies. After a couple of minutes Liam comments

on Carin's whiteboard notes and Rebecca, somewhat frustrated, asks:

> *Liam: Carin I am allergic to all the things you have written on the white board.*
> *Rebecca: What is friction? What is friction? But what is friction?*
> *Carin: I want you to explain it in the report.*
> *Rebecca: But how?*
> *Carin: Think about this: what comes down fastest?*
> *Rebecca: I can't do anything when I don't know what it is.*
>
> *Liam: Carin jag är allergisk mot allting du skrivit upp.*
> *Rebecca: Vad är friktion? Vad är friktion? Men vad är friktion?*
> *Carin: Jag vill helst ha det i rapporten.*
> *Rebecca: Men hur?*
> *Carin: Ni ska tänka så här vilken, vilken kommer ner fortast.*
> *Rebecca: Jag kan ju inte göra något om jag inte vet vad det är.*
> *(Excerpt 7.3 audio recording, lesson 2012-02-03)*

One group decides they want to reach a higher grade in this experiment which means they have to do the laboratory report without a template. One of them states "*Let's go for the higher level*" ("*Vi kör på den högre nivån*") but immediately after says "*I don't get what we should do*" ("*Jag fattar inte vad vi ska göra*"). Carin finishes her teaching, Nicholas immediately raises objections:

> *Nicholas: But I do not know what to do.*
> *Carin: You should write a lab report.*
> *Nicholas: But what is it all about? But what is it about?*
> *Carin: You should find out which of these materials has the least friction.*
> *Nicholas: What is friction?*
> *Carin: Friction, I just told Rebecca.*
> *Nicholas (turning to Rebecca): Rebecca, what is friction?*
> *Rebecca: I do not know.*
>
> *Nicholas: Men jag fattar inte vad vi ska göra.*
> *Carin: Ni ska skriva en laboration.*
> *Nicholas: Men vad är det laborationen går ut på? Men vad går den ut på?*
> *Carin: Du ska ta redan på vilken av de här materialen som har minst friktion.*
> *Nicholas: Vad är friktion?*

164

> Carin: Friktion, det berättade jag precis för Rebecca.
> Nicholas: Rebecca, vad är friktion?
> Rebecca: Jag vet inte. (Excerpt 7.4, audio recording, lesson 2012-02-03)

Nicholas starts to work, finding ways forward; other groups though have problems and Carin starts to walk around among the groups helping out. Liam asks his classmate at his desk: "*Hey, I do not understand, can you help me or what?*" *("Hallå, jag förstår inte, kan ni hjälpa mig eller?")*. Matthew expresses uncertainty about how to start to work and plan their laboratory work: "*Should we write a hypothesis as well? Should she do it too? Hey! Carin!*" *("Ska vi skriva hypotes också? Ska hon också göra det? Hallå Carin!")*.

The next day the students continue with their laboratory work they planned yesterday. The questions continue. Matthew though has not any issues at the moment and shows Joshua a neat and descriptive picture how to perform the laboratory work. *"This is class!"* *("Det här är klass")* Matthew proudly states with a loud voice and continues to work. A number of students though do not know what to do or how to do it. Some look at their laboratory work criteria that were handed out yesterday. Similar to other lessons, Carin walks around in the classroom trying to straighten out the students' questions, seventeen to be precise.

The following week, Rebecca and Charlotte have problems working with newtons and kilos. Carin has taught about the dynamometer and motion, but when they start with the experiment, they have problems:

> Rebecca: I just don't get it. But I just don't know what you should do. What is ma? How do you calculate mass? Well, thanks for helping out. (Ironic voice) Should we write in the book?
> Charlotte: Yeah, do that. I don't get it.
> Rebecca: It doesn't tell you what we should do. I don't understand anything. And you can't get any help from her either.

Rebecca: Jag fattar ju inte. Men jag fattar ju inte hur man gör.
Vad är ma hur räknar man ut massan? Ja men tack för hjälpen
då. (Ironisk röst) Ska man skriva i boken?
Charlotte: Gör det. Jag kan inte.
Rebecca: Det står väl inte hur vi ska göra. Jag kan ingenting.
Och man får ingen hjälp av henne heller. (Excerpt 7.5, audio
recording lesson 2010-02-08)

Finally Rebecca asks Carin: "*Can you get any help?" ("Kan man få*
någon hjälp?") ending up expressing her frustration: *"I don't get it.*
I don't get it." ("Jag förstår inte. Jag förstår inte").

"We will pimp up our car sooo much"

Carin tries to help out. However, when she leaves Rebecca and
Charlotte there are new questions, this time about how to write the
report. Rebecca asks Charlotte "*Should I write in the book?"*
("Ska man skriva i boken?"). She does not get any help from Char-
lotte: she does not know either. Liam has problems during this les-
son as well: "*But how do I write Newton then?" ("Men hur skriver*
jag newton då?"). It is clear that the students do not understand
what to do, or how to do it. The focus is not on the science content
but rather their problems regarding how to write the report or the
design of the report or what they construct. The students have
trouble finding out both what and how.

Questions regarding how to write the report have been seen in ear-
lier lessons. During the lesson the week before, the students ask a
lot of questions like: *"Should you draw a picture too?" "Should I*
copy this and then write it here?" ("Ska man rita en bild också?
Kan jag skriva av det och skriva det här nere?"). Liam has prob-
lems; so does Nicholas: *"Should you make a clean copy here later*
on?" ("Ska man renskriva den här sen?"). Joshua is insecure about
how to write his report and anxious about writing the right thing:

Joshua: Is it ok that I write it on this page?
Carin: That could be the conclusion.
Joshua: Aha, but the result, can it be just like this or?
Carin: Yes [inaudible].
Joshua: But if you want to get a good grade, what are you sup-
posed to do?

Carin: Then you should write a really good conclusion.

Joshua: Kan jag göra på den sidan?
Carin: Det kan vara slutsats.
Joshua: Aha, men resultat, kan det bara vara så här eller?
Carin: Ja (ohörbart).
Joshua: Men om man ska få bättre betyg, hur ska man då göra?
Carin: Då ska man skriva en väldigt bra slutsats. (Excerpt 7.6, audio recording, lesson 2010-02-04)

Repeatedly he asks Carin: "*Carin, can you write like this; 'Take a carton' or should you write; We took?" ("Carin, ska man skriva så: Ta en kartong eller ska man skriva: Vi tog?").* Like Joshua's, most of the questionss that the students put to Carin are not in regard to the content or scientific concepts. Instead, the questions regard the form of the text and arrangement of words. The questions continue when the students are finishing their reports; Joshua asks Carin "*Carin, theory, is it something you write in the beginning, what you thought?" "What do you do when you reflect upon the laboratory work?" ("Carin, teori, är det det man skrev i början vad man trodde?" "Vad gör man i en reflektion?").*

The strong emphasis on how to write and the design of the report continues into the next unit when building model cars. Few of the groups think about the technology in the cars, instead it is the form and design of the cars that are in focus. Rebecca and Charlotte have an on-going discussion in their group when they start to build their car. They discuss boyfriends, latest clothes but also the design of their car:

Rebecca: It would have been cool with a black car.
Charlotte: No no.
Rebecca: We will get PWD before the summer.
Charlotte: And our car will look so nice.
Rebecca: Look how cool theirs is!
Charlotte: Look at ours.
Rebecca: Don't rubbish our car now Charlotte (ironic voice).
Charlotte: This is commitment! (ironic voice)
Rebecca We will pimp up our car sooo much.
Charlotte: I've made a sunroof.
(Giggles)

Rebecca: Det hade varit kul med en svart bil.
Charlotte: Nähej.
Rebecca: Vi ska ha VG på vårt betyg innan sommaren.
Charlotte: Och vår bil ska bli fin.
Rebecca: Kolla de har sån fin.
Charlotte: Kolla vår.
Rebecca Mobba inte vår bil nu Charlotte.
Charlotte Engagemang heter det.
Rebecca Vi ska pimpa vår bil as-mycke.
Charlote Jag har gjort en taklucka.
(Fnitter)(Excerpt 7.7, audio recording, lesson 2010-03-01)

Carin recognizes what is going on in the classroom, and encourages them to *"think about how it will work, that is the technology in it"* (*"Tänk nu på hur den ska gå, det är det som är tekniken i det").* Carin reflects upon this with me and states in end of the first lesson on building model cars that "*They're only thinking about the exterior right now."* ("*Nu pysslar de bara med ytan*") (Fieldnotes 2010-03-01).

There are a lot of options and a lot of freedom in the laboratory work lessons. However, what is happening is that the students raise many questions and frustrations. In one lesson Carin recognises the problems and interrupts the laboratory work and start to teach instead from her teacher's desk. In other lessons she has a hard time struggling to help all the different groups with all their questions and issues walking around in the classroom trying to help as many as possible.

Raising similar questions as the students regarding the what and the how; What is happening during these lessons? How is it happening? Using the theoretical framework; what is going on in the laboratory work episodes? How can the organization of the activity be understood? How does it relate to the science education field? And what is valued and important? How can this be understood in relation to social class?

7.2 Interpreting laboratory work

"I can't do anything if I do not know what it is"

The laboratory work episodes are filled with questions and a number of students have problems understanding what to do during the laboratory work episodes. They have recognised that there is something that they should do, but what and how? This implies that they have to ask the teacher over and over again, or that they are left with the questions in their group. Rebecca gets noticeably irritated when she and Charlotte work together as usual at their desk. Carin helps other groups and Rebecca states irritated: *"And you can't get any help from her either. (Irritated) Can you get any help?"* (*"Och man får ingen hjälp av henne heller. (Irriterat) Kan man få någon hjälp?").* Rebecca and Charlotte try to solve the task they are given. However Rebecca does not understand how. Rebecca has recognised (cf. Bernstein, 2000) that something should be done but neither she nor Charlotte have realisation rules for the goals they strive for. For Rebecca it is a matter of *"I can't do anything if I do not know what it is"* (*"Jag kan ju inte göra något om jag inte vet vad det är")* and *"How are you supposed to know that?"* (*"Hur ska man veta det?"*). Is it something that she should have understood? Rebecca blames herself in just the way Lemke (1990) feared the student would do in the science classroom.

Rebecca and Charlotte sometimes feel that they are unfairly evaluated by Carin. Rebecca states " *We are bloody hell always working. We don't talk, we don't. Now I'm irritated."* (*"Vi jobbar fan alltid. Vi pratar inte, ändå, det gör vi inte. Nu blir jag sur").* Rebecca also state in the interviews that she feels they do everything right and yet others *"get the same kind of grade as me, even though I sit and work, anyway working most of the time and do what we have to do. And we get the same grade as those who don't."* (*"typ typ sitter och jobbar i alla fall sitter och jobbar för det mesta och gör det vi ska").* Rebecca and Charlotte have interpreted the situation differently from what Carin had aimed for. They lack the resources or cultural knowledge - i.e. a cultural capital (Mehan, 2008) - that would have enabled them to manage and understand what to do

and how to do it in this specific situation. The misunderstandings and lack of a cultural capital valued in this specific field leads them to focusing on the wrong thing (such as the design). Rebecca and Charlotte seem not to have acquired familiarity and understanding which could have given them advantages in this situation (Mehan, 2008) and the laboratory work episodes leave them outside the game, frustrated, feeling unfairly evaluated and blaming themselves.

Rebecca and Charlotte have many things in common; they share same interests, dress in a similar way, talk and gesture in the same way. They both express low expectations and self-esteems. When comparing their answers on the questionnaire, Rebecca and Charlotte have more resemblance than Charlotte has with her twin brother Connor in the class. Charlotte and Rebecca construct each other and are constructed by others as one person. They also talk about their grades and results as if they shared the very same grade. Thus, in many respects they could be constructed in the very same social class. There is no indication that Rebecca and Charlotte do not accept instrumental discourse (Bernstein, 1975), but they do not know how to deal with the regulative discourse. In other words, they lack realisation rules for the discourse that always override the instructional discourse and are decisive in the classroom. Rebecca and Charlotte do not manage to understand the codes and they lack cultural capital to interpret the situations. Instead they are left to each other. Since they support each other, adding value to what they think is important; they are trapped in their little group. This entails, for example, that they must ask Carin over and over or again. They are given options and spielraum (Roth & Tobin, 2001), but cannot make use of it: freedom of choice is a chimera.

Like Rebecca and Charlotte, other groups in the classroom, e.g. Lucy and Laura's group, construct each other in similar social class. Together with friends, Lucy and Laura can act in a more secure way, having a feeling for the game and probably making use of another form of cultural capital that is valued in their group.

Lucy, Laura, Rebecca and Charlotte are not at home with the laboratory work. Instead their groups become their important playing ground and this becomes decisive when it comes to how they should act and do and what is valued and not.

There is an interplay between what is going on in the groups and the effect the groups exert on their members, which becomes important to bear in mind when understanding what is happening and why some students don't get it or don't solve the tasks. In addition, this interplays with the specific activities that are carried out in the science classroom. Therefore, when trying to find out what ways of acting and talking that are valued in the science classroom and how these are valued, the social class relationships are crucial.

Regulative discourse vs. instructional discourse

Laboratory work in 8D's classroom is filled with uncertainty and questions: foremost questions that regard the form, the design of reports or constructions rather than scientific content and concepts. It is the regulative discourse (Bernstein, 2000) that the students ask about. The instructional discourse, the transmission of knowledge concerning for example friction or Newton-meter - which probably was one of the important aims of laboratory work - is not in focus. Joshua always turns to the teacher in these weakly framed practical activities. He cannot use effectively the options and the room to manoeuvre that he is given and he becomes insecure and lacks self-confidence. It is as though he needs immediate reassurance, like when he is a sounding board, to feel comfortable and search for a way to do the right thing. Even though the students have several hand-outs that can help them write the report, Joshua asks a lot of question about this. He gets stuck in the regulative discourse that he knows he has the capability to handle. It might be so that he has large problems with the instructional discourse; there is indication from Carin about that. This might therefore be Joshua's way to deal with this and to reach the goals that he aims for. In the end, he gets the answers he needs regarding the regulative discourse and can, like Matthew for example, go on and produce a well written report.

The regulative discourse in the laboratory work in the classroom totally overrides the instructional discourse and becomes the most important and decisive aspect of this practical science activity. Even though this is a subject strongly influenced by its socio-historical legacy with facts and figures and non-negotiable knowledge, it is ironically not the content - the scientific knowledge the curriculum asks for - that is decisive. Therefore, those students that have cultural capital that gives value to or could be exchanged in the regulative discourse have better chances and show how "those with the appropriate cultural capital are reinforced with 'success', while others are not" (Harker, 1990, p. 118). This correlates with the conclusions Lemke (1990) and Ross, Dooly and Hartsmar (2012) made. Educational success in the school science field not only concerns the content but also familiarity with ways of talking and communication (which is often in implicit patterns). It is the organisation of content rather than the mere content that is important.

My interpretation after the time spent with Carin is that she has many good intentions when she time after time sets about different laboratory experiments with lots of options for the students. Carin also states that she thinks laboratory work is important. They can be lessons filled with curiosity, freedom and exciting challenges, fulfilling curricular goals and societal expectations. In the end, however, these activities turn out completely differently and not what curriculum, pedagogy or evaluation aimed for. And this is not the end of the story. When Carin one Wednesday afternoon, in the middle of the unit, rearranges the groups where they perform laboratory experiments, the classroom bristles.

7.3 Rearranging the laboratory groups

> *Carin: Matthew sit here, please.*
> *Matthew: Well no, I have already sat there once. Who will sit there with me? Nobody gay.*
> *Carin: Hey, you, what was that? If anybody is gay, they have a perfect right to be.*
> *Matthew: Ahhh. Who else will sit here?*
> *Carin: I will tell you later.*
> *Carin: Matthew ska sitta där.*

Matthew: Nae, jag har redan suttit där en gång! Vem ska mer sitta här? Inte någon bögig.
Carin: Du, vad var det? Om någon är det så får den vara det bäst den vill.
Matthew: Amen. Vem ska mer sitta här?
Carin: Det ska jag säga sen.

Nicholas: What the hell, you move us but not
Matthew: Why don't you move them too? And them??
Nicholas: Yes exactly, mean!
Carin: I will move the girls next time
Students (mostly girls): No, no!
Carin: If it has to be fair, it has to be fair.
Joshua: I will place myself here, I can't do anything sitting there.

Nicholas: Fan du flytar på oss men inte på…
Matthew: Varför flyttar du inte på dom och dom?
Nicholas: Ja precis, elakt!
Carin: Nästa gång ska jag flytta på tjejerna.
Flera (mest tjejer?): Nä nä!
Carin: Ska det vara rättvist, ska det vara rättvis.
Joshua: Jag sätter mig här för jag orkar inte sitta där. (Excerpt 7.8, audio recording lesson 2010-02-03)

Matthew continues to complain and mutter loudly to himself about his new place:

Matthew: Are they retarded? Joshua, we have to be the new teachers. … Who will sit with Nicholas?
Nicholas: Nobody.
Carin: Liam.
Matthew: Well, that is cool. (ironic voice)
Nicholas: It is, in one way
Carin: Well, everybody, listen up, let's all be nice to each other
Nicholas: Can I get Michael also? (ironic voice)

Matthew: Är de såna retardsbarn? Joshua, vi får vara nya lärare.… Vem ska sitta med Nicholas?
Nicholas: Ingen.
Carin: Liam.
Matthew: Amen det är ballt (ironisk röst).
Nicholas: Det är i och för sig
Carin: Nämen, hörni, nu är vi snälla mot alla klasskamrater.
Nicholas: Kan jag få Michael också? (Ironisk röst) (Excerpt 7.9, audio recording lesson 2010-02-03)

The rearranging leads to an unusual storm of protest and the classroom becomes chatty and noisy. It is above all Matthew and Nicholas who explicitly oppose the rearrangement in the classroom. However, the girls raise their voices as well. When the class has calmed down, Carin goes on with the whole-group teaching. Carin states "*All groups, you do the experiment in groups, and you write it up together*" *("Alla grupper, ni laborerar i grupp, ni ska skriva tillsammans").* However, again, someone asks about the teams and how to work: *"What groups are there?" ("Vilka grupper är det?").*

Later on, one group of students is discussing the rearrangement and the possibility of getting the grades they strive for. Nicholas and Liam discuss with James:

> *James: Actually I should be with Jack.*
> *Nicholas: What the hell.*
> *James: We all got, you know, Joshua got her, Matthew got Danielle, Nicholas got you and I got Jack even though he is the smallest.*
> *Liam: And I got you Nicholas! (Ironic happy voice)*
> *James: Come on now Nicholas, you can make it!*
> *Nicholas: We? You? Well there go our chances of getting PWD and PWSD now.*
> *Liam: It's a pity you got me.*
> *Nicholas: No well, but it's not hard to work with Joshua.*
> *James: It's a pity he got you.*
> *Nicholas. I'll never get PWSD.*

> *James: Jag ska egentligen göra med Jack.*
> *Nicholas: Amen va fan.*
> *James: Alla fick så där… Joshua fick hon, Matthew fick Danielle, Nicholas fick dig och jag fick Jack fast han är minst.*
> *Liam: Och jag fick dig Nicholas!*
> *James: Kom igen nu Nicholas, du klarar det!*
> *Nicholas: Ni? Du? Alltså det stör liksom våra VG och MVG mål nu.*
> *Liam: Synd att du fick mig.*
> *Nicholas: Nej, men det är inget jobbigt att jobba med Joshua.*
> *James: Synd att han fick dig.*
> *Nicholas: Jag kommer aldrig få MVG. (Excerpt 7.10, audio recording, lesson 2010-02-03)*

James and Nicholas understand that Carin has placed "good" students such as Joshua, Matthew and Nicholas with "bad" students such as Danielle, Liam and Jack. This will, according to them, hinder their chances of higher grades and their ability to work fluently.

It seems as though the students worry about changing seats. In the middle of the unit, the questions comes: "*Will we change places today?*" (*"Ska vi byta platser idag?"*). When the unit in mechanics is over and the students start building model cars, the question returns. Lucy is reading the daily program on the whiteboard and comments on this to her group: "*'Plan to build something in technology'. Not if we have to do it alone, then I'll get DAMP*" (*"Planera att bygga nåt i teknik. Inte själv om vi ska bygga själv kommer jag få damp"*). Some student shouts out loud in the classroom:

> *Student: In teams?*
> *Carin: Yes.*
> *Student (quietly): Yeah!*
> *Carin: Or individually if you want to, but you can work in teams if you want to.*
>
> *Student: I grupp?*
> *Carin: Ja.*
> *Student (tyst): Yeah!*
> *Carin: Eller individuellt om man vill det men man får bygga I grupp om man vill det. (Excerpt 7.11, audio recording, lesson 2010-03-01)*

When they are about to start up the construction of the car in this new unit, Matthew asks Carin about the team constellations and Nicholas expresses that he does not want to work by himself:

> *Matthew: Are you allowed to work with somebody else?*
> *Nicholas: But what the hell. Then I don't have that much of choice really because I sit with Liam and he is away half of the time.*
>
> *Matthew: Nicholas, you are allowed to work alone without the one you sit with.*

Nicholas: But I don't want to work alone [inaudible].

Matthew: Kan man jobba med någon annan?
Nicholas: Men va fan. Då har jag inte så stort val eftersom Liam är borta halva tiden.

Matthew: Nicholas, man kan jobba själv men utan dom man sitter med.
Nicholas: Men jag vill inte jobba ensam [ohörbart] (Excerpt 7.12, audio recording, lesson 2010-03-01)

They rearrange. Nicholas, however, asks with some anxiety *"What now, how did this end up? Matthew?" ("Hur blev det nu? Matthew?").* Finally Matthew moves to Nicholas and tells Nicholas: *"This will be alright now, PWSD-level" ("Nu ska det här blir bra, MVG-nivå").*

7.4 Interpreting laboratory work as group activity

Room to manoeuvre

How can these group constellations and the reactions on changing groups be understood? There is nothing that causes so many outspoken feelings in the classroom than the rearranging of seats. It becomes explicitly clear that the students have placed themselves in a hierarchy, based on who is to be considered a good student or a bad student. When the classroom is rearranged, the student's different status and reputation becomes visible and explicit. It becomes open for evaluation by the students and at the same time in a distinct way makes obvious the differences in the group as the students see it. The students have recognition rules for these things and when rearranging in the classroom takes place it becomes evident that some students have higher value than others. They, as Bernstein (2000) states "can recognize the power relations in which they are involved, and their position in them" (p. 17). In the rearrangement and the group work, the different status and places on the ranking list of students become visible through a kind of social discourse. The practice constructs and manifests the students' different status. Similar to the social discourse that surrounds the school and the village, each student is surrounded by a social dis-

course that constructs each and every student and gives them certain dispositions in this classroom. The classroom can be understood as a field, a room where dispositions and practices develop and become visualised (Bourdieu, 1998; Gytz Olesen, 2004).

Could social class be understood in relation to this science activity? I claim it can. Social rank and status is one ingredient when establishing social class. The student and the teacher construct each other in different social classes depending on their social rank. Social class cannot be understood by socioeconomic factors only. The effect of this hierarchical class marking process becomes decisive in the classroom. Liam is one illustrative example.

Liam – social discourse and social class

Liam is considered to be one of the low status students, clearly expressed to him and his classmates at the desk. Liam knows that the way he acts and talks entails problems for him; he has recognition rules (Bernstein, 2000) for what is going on. "*It's a pity you got me*" *("Förlåt att du fick mig")* he replies to Nicholas. And in the interview Liam expresses that "*It feels like I have some kind of penalty point*" *("Det känns som om jag har en prick")* about the way he is seen in school. Using Bourdieu's (1990) tool, he expresses possibilities and dispositions that could be rooted in his habitus. These are in turn built up by for example expectations (also see Reay, 2004) that most likely will acted out in the activities and the practices in the classroom. This becomes painfully clear when looking at Liam. Liam is part of the social processes but the processes also construct Liam: he manifests that "the body is in the social world but the social world is also in the body" (Bourdieu, 1990, p. 190). For example; Liam often comes late but often stays when the other has left the classroom to finish his task, paying no heed to the rest of the class or the schedule. Carin asks him about working in groups during one of these episodes.

> Carin: Hey, Liam, do you want to work by yourself, or do you want to work with somebody else?
> Liam: (silence)

Carin: Does it feel ok to work with others; does it feel ok to work with Joshua?
Liam: What?
Carin: Or I mean Nicholas and
Liam: James.
Carin: James?
Liam: Yes, yes.
Carin: That's good.
Liam: But it is boring for them if I come too late and then they have to wait.
Carin: Yes, yes, well then they can start on their own.

Carin: Du Liam, vill du helst jobba själv, eller vill du jobba tillsammans med någon annan?
Liam: (silence)
Carin: Går det bra att jobba tillsammans med, går det bra att jobba med Joshua?
Liam: Va?
Carin: Eller jag menar Nicholas och
Liam: James.
Carin: James?
Liam: Ja ja.
Carin: Det är bra.
Liam: Men det är tråkigt för dom om jag kommer för sent, då måste dom ju vänta.
Carin: Ja ja, men då kan dom ju göra själv ju. (Excerpt 7.13, audio recording, lesson 2010-02-04)

Carin shows that she has recognition rules for what is going on in the groups. At the same time, she is legitimizing that it is ok for Liam to come late and that the others can go ahead without him. My interpretation of the way Carin acts toward Liam throughout the unit is that she is happy he attends the class as often as he does. Even though the other students are not giving him room to manoeuvre, she gives him space to act in certain ways that is not given other students. However, when having many group activities, Liam's status and social rank over and over again are manifested in the intricate interplay between what is going on in the groups and the effect the groups exert on their members. And maybe his way of dealing with the way he is constructed, is more resistance, more late arrivals or messing around in or outside the classroom i.e. being, fulfilling and creating the way he is constructed.

Carin thinks Liam is bright and actually could have good chances. She constructs Liam in another social rank than his classmates and surrounds him with another social discourse. In contrast with other students, Liam surprisingly often has comments that deal with the instructional discourse (Bernstein, 2000) and often has questions or comments in the classroom regarding the scientific content. However he resists in many respects the regulative discourse in this classroom. Since the regulative discourse is important in the classroom and for his classmates, this becomes troublesome and in the group activities he is not (allowed to be a) part of the game (Bernstein, 2000; Bourdieu 1990). The reactions and the social discourse that surround Liam show that "a gift is nothing other than the feel for the game socially constituted by early immersion in the game" (Bourdieu, 1990, p. 109). Being gifted according to the student (not by Carin in this case) means having a feeling for the game that provides value and a room to manoeuvre. Liam does not have that. Liam accepts in many ways the instructional discourse in school (Bernstein, 1975). He is interested in science and he wants to get good grades to be able to find a good job: school is important, he states. However, without the regulative discourse, with a non-valuable social discourse and without means or tools that support him, he is not part of the game.

Nicholas – holding the number one ranking

In contrast to Liam, the social discourse that surrounds Nicholas gives him perhaps the highest position on the social ranking list. Nicholas could be said to be completely in his element when it comes to laboratory work. This happens even though he has expressed disinterest in science (also in contrast with Liam). He also constructs himself as someone with a laid-back attitude with utterances like *"we did something at least" ("vi gjorde i alla fall nåt")* and someone not interested in science. However, when he starts to do laboratory work he acts really interested and engaged. During one episode, Nicholas is working with James. They appear to get on really well and distinguish themselves from everybody else in the classroom. They work along with their problem, develop their ideas and do not wish to stop when the rest of the class has re-

moved their laboratory equipment and started to write their report. They clearly act completely at home (Bourdieu and Wacquant, 1992), they are curious and engaged and they can easily recognize and realise how to carry out the laboratory work. The way they behave "operates below the level of calculation and consciousness" (Mills, 2008b, p. 100), providing them both with a sense of how to act and respond. According to Mills' argument, this is due to their habitus. However, if Nicholas works within his habitus when working with, for example, James, he becomes insecure when starting up the weakly framed laboratory work with the template. In contrast to others who become silent, and contrary to the laidback attitude he sometimes constructs, he starts to raise objections: *"But what is this all about?* **But what is it about?** *(*"Men vad är det laborationen går ut på? **Men vad går den ut på?**")*. However, when Nicholas has talked with Carin, straightened out the questions, he starts to work. He makes sure that he gets the realisation rules. He is given and taken opportunities and can make use of the options and freedom that is given him in this classroom by the students and the teacher. Like Liam, Nicholas visualises that "a gift is nothing other than the feel for the game socially constituted by early immersion in the game" (Bourdieu, 1990, p. 109).

If Liam is not part of the game, Nicholas makes sure he is (even though he constructs himself without interest and with a laid-back attitude). For some reason, one Friday afternoon, Nicholas works together with another student, Michael. Their conversation is not easy and instead Nicholas bosses Michael around saying for example: *"Get the rules, Brown!" "Can't you go and get the ruler? "What are you doing now?" (*"Hämta linjalen Brown!" "Kan du inte hämta linjalen?" "Vad gör du nu?")*. When it comes to the final answer, Nicholas turns to Joshua who he prefers to get answers from: *"What did you get Joshua?" (*"Vad fick du dina till Joshua?")*. However, turning to Joshua when it comes to the answers seems not enough for Nicholas. He constructs Michael in a lower class than himself. As stated earlier, Nicholas' and Michael's mothers work in the very same supermarket in Westvillage. However, when Michael says that his mother has *"same fucking work*

as Smith's [Nicholas] mum" *("Samma jävla jobb som Smiths [Nicholas] morsa").* Nicholas respond immediately*: "My mum is boss there"* *("Min mamma är boss där").* Nicholas clearly demarks himself from Michael. In actions and words, Nicholas constructs Michael in another class than him and Nicholas constructs himself as someone with higher status in the game. This form of dialogue is never heard when Michael works with his closest friend, William, nor when Nicholas talks with some of his closest friends. When they sit by themselves in their own group they cooperate within their group and with similar expectations, features and characteristics in their own network, in their own group with their social class.

Colliding codes

What becomes problematic with the laboratory group tasks is not only the social discourse and ranking. In addition and in correlation with this, there are colliding codes in the classroom. According to the criteria, the students have to plan, risk evaluate and carry out laboratory work on their own, if they want to reach level four and five (out of five). In other words, in order to get good grades it is better to work by yourself. This means that resisting the common and taken for granted way of working in groups actually gives greater possibility to achieve, according to the criteria - or at least according to one of the criteria. Nevertheless, doing that breaks the taken for granted rule that it is good to work in groups: a rule that is emphasised by the teachers and also by the way the classroom is physically built with stationary desks and by the fact that there is not enough laboratory equipment to perform laboratory experiments by yourself. The contradiction becomes evident in a dialogue between Carin and Lucy when they have done their experiment and are supposed to write the report. Note the pronoun used, Carin uses the plural-form (pl.) of you:

> *Carin: Lucy has them I can see, can I see them then I will explain to you [pl.], when you [pl.] have left this one you [pl.] have already written the material and you [pl.] have already risk evaluated and you [pl.] have already written the hypothesis so we don't have to do that, you have already done that here.*

Then you [pl.] write how you [pl.] carried it out, how you [pl.] did it. You [pl.] can show the results in a table. And then conclusions. And then when you [pl.] write the conclusion.
Lucy: By myself?
Carin: It should be individually, yes.

Carin: Lucy har dom ser jag, får jag titta i den dom så ska jag förklara för er, när ni lämnat i denna har ni redan skrivit materialet och ni har redan riskbedömt och ni har redan skrivit hypotesen så det behöver ni inte göra, det har ni redan gjort där. Då ska ni skriva utförande nu er hur ni gjorde. Resultat kan ni gärna redovisa i en tabell. Och sen slutsats. Och när ni skriver slutsats.
Lucy: Själv?
Carin: Den ska vara individuellt, ja. (Excerpt 7.14, audio recording, lesson 2010-02-04)

The question put out by Lucy is relevant. If being properly evaluated according to the matrixes the students have to resist the common and expected way of working in teams. Joshua deals with this working by himself. Others start to work in their groups, trying to solve the task.

Evaluation in the Swedish school is individual; however, the doxa, the unconscious values and presuppositions of the science field (Bourdieu, 1992) in this classroom say that the students should work in teams or in pairs. However the regulative principle, the code (Bernstein, 1975) works towards an evaluation that is individual. There are doxa that expect cooperation and a code that rewards individuality. According to the national curriculum, the students must show that at the end of the final year nine they:

> can talk about and discuss questions concerning… In their discussions, pupils put questions and put forward views and respond to views and arguments in a way which carries the discussions forward and deepens or broadens them. … Pupils can use the information in a well functioning way in discussions and create well developed texts and other communications (SNAE, 2011b, p. 129).

I claim it is hard to reach a good grade in physics without interaction and working in groups or and pairs if acknowledging the

knowledge requirements of the curriculum. Seen from this perspective, Carin tries to follow the curriculum. In other words, it is not only the doxa in this classroom that state that you should work in teams, it is written in the curriculum, it is also a regulative principle, a code. In other words, there are at least two parallel codes in the curriculum. My interpretation is that Carin unconsciously tries at the same time follow the code, the regulative principle, regarding requirements of individual grades and at the same time the code, the regulative principle that states that you should work in teams and pairs to reach good grades. In addition, there are doxa in the science education field regarding the way the classroom is built and the way laboratory work is often performed that presupposes group work.

Bernstein (1975) noted in one of his early articles that "Curriculum defines what counts as valid knowledge, pedagogy defines what counts as valid transmission of knowledge, and evaluation defines what counts as a valid realization of the knowledge on the part of the taught" (p. 85). In laboratory group work, the pedagogy and curriculum are in conflict with the evaluation. Neither the teachers nor the students have a fair chance to manoeuvre or to decipher what code counts as valid realization. Contrasting this with the evaluation process that always works towards individual grades makes it hard for students to understand what rules that are in force and for Carin who must decipher the curriculum and in addition take into account the science education socio-historical legacies with its doxa. This classroom and the way it is built demands of the teacher that the students work within a legacy which actually makes it harder to get good grade. There are colliding codes. One code that says that working in teams is a good way to work and another code that says that evaluation is individual. Those who can interpret what is valued and have greater possibilities of success either by seeing what to do and supporting the others in the group or by resisting the group when necessary. Mehan argues that a "student's successful participation in classroom lessons is at least partially determined by their abilities to deal with this conflicting information" (p. 124-125). A student who can deal with this con-

flicting information and can make a decision, that can make the distinction (Bourdieu, 2010) between what code to follow in different episodes, can also make successful choices. They can do the right thing at the right time. Bringing into this the doxa in the science education field makes laboratory work something extremely complicated that could not be taken for granted.

Joshua – doing the right thing?

Joshua tries to do the right thing at the right time; he seems to own recognition rules (Bernstein, 2000) in handling laboratory work, to get room to manoeuvre and to reach the grades he strives for. Similar things happen with Matthew and Nicholas during another lesson. Even though they are not sitting together they cooperate across the classroom and ask and support each other throughout the lesson. This can go on albeit at the expense of others. For example, during one laboratory experiment this becomes problematic since Joshua does not have a small wagon to use when trying out friction. Carin points to the fact that they do have a carriage, Connor has it and they should work together. Joshua distinctly tells Connor that he can copy his answers. Instead of cooperating, Joshua solves his problem by borrowing a wagon from the girls on the desk behind, they end up without one and have to nag at Joshua to get the wagon back. In the end, Joshua realises his goal, working by himself doing what is asked of him in this laboratory work. He writes his report and is rewarded with the grade of pass with distinction. The other students who do not resist the grouping in the classroom, are more or less committed to their places in the hierarchy or to what members that could be found in their group (such as James when working with Nicholas).

Joshua has realisation and recognition rules in many situations. However, when it comes to team work he seems to have recognition rules for the evaluation code and he realises it in his own way according to his priorities (grades) (Bernstein, 2000). School is a way to reach his goals, not to fulfil his interests. Probably unconsciously and instinctively he knows the rules and which code to adapt to and when in order to reach the goal he strives for. Joshua

tries to work by himself as often as possible even though the rest of the students in the class work in teams or pairs. If he cooperates with somebody it is Nicholas or Matthew. The reasons could be several, such as that they are friends and share similar interests. In addition, they also share the same background and similar socio-economic status. They are also seen as good students by the rest of group. Nicholas express that *"well, no, it's not hard to work with Joshua"* (*"nej, men det är inget jobbigt att jobba med Joshua"*). Joshua, Nicholas and Matthew are students that could be said to be members of the same social class in this classroom. Nonetheless, during most lessons Joshua works by himself even if team work is possible. And Joshua states about his classmates *"and they don't exactly help either"* (*"Och dom hjälper mig inte direkt"*). Joshua states that working by himself he *"feels better, yes, it feels safer that way"* (*"känns bättre, ja det känns säkrare så"*) for his grades. Some students (e.g. Lucy and Rebecca) seems to express the opposite, feeling safe within their groups. In the end, Joshua receives best grade of them all on this activity, followed by Nicholas and Matthew. He fulfilled his goals by working by himself. He chose to follow one code even though it collided with another code saying what was desirable in this situation. In the end he did the right thing, if looking at the grades awarded.

Rebecca - doing the right thing?

In contrast with Joshua, Rebecca and Charlotte always sit and work together, right behind Joshua. When comparing the answers from the test given a couple of weeks into this unit, Rebecca and Charlotte have similar answers. This is not due to cheating. The fact is that they write almost the same things throughout the unit, on tests, reports and tasks. They also get the same grades on all parts of this unit in mechanics. There is neither an individual Rebecca nor an individual Charlotte, they work, act and talk as one person. In the end when their results are summarized they both receive Pass+ and exactly identical written assessments. They construct each other and they are constructed by others as one person and acts as twins. Charlotte says: "*We are twins for that matter, so we think in the same way, so we will get PWD both of us.*" (*"Vi är*

*i och för sig tvillingar, så vi tänker likadant så vi kommer få VG
båda två").* She is immediately supported in her statement by Re-
becca saying: "*So we are like one person." ("Så vi är som en per-
son").* As a result, or due to this, they also have the same expecta-
tion of their grades: pass with distinction. They also talk about
their grades and their results on this unit as if they should have the
very same grade, using the pronoun "we "(Swedish: vi) when they
actually talk about their individual grads saying for example (when
they are asked about their expectations on their grades): *"Let's
write PWD" "Should we write PWD+?"* ("*Vi skriver VG" "Ska vi
skriva VG+?").* Rebecca and Charlotte act, talk, dress and seems to
think in similar ways and seen from that perspective, they put
value into and use similar resources and dispositions - i.e. they
could be said to belong to similar social class. They put value into
the same things when it comes to clothes, make up and interests,
but also grades, interest and expectations.

As a result of their cooperation they write extremely similar labo-
ratory reports which show they are not independent - which Carin
wanted them to show. They have not realized that it is not only
about doing the right thing that is important and that what Carin
asks for is individuality, not writing similar reports that expose a
lack of independent thought. They interpret the message system in
another way. Working in groups where they can construct each
other similarly and add value to what they think is important and
according to one code actually decreases their chances.

Laura – doing the right thing?

In another group, Laura is more or less trapped, but hardly visible.
Laura is extremely silent in the classroom, seldom raises her voice
or takes part in the classroom activities. However, it seems as
though she is trying and working, which Carin has seen. Laura of-
ten sits with or close to Molly and Lucy. During one lesson class
8D has science with a substitute teacher that they know well. This
teacher thinks that Laura, Molly and Lucy are not doing what they
are supposed to do and nag them. When the substitute teacher
leaves the group they do nothing; they start giggling and Laura is

the only one that goes on with the exercises, asking her friend at the desk: "*Do you know the fifth one?*" (*"Kan du femman?"*). However, the other girls continue to mess around, not as loudly as the boys, but disturbing each other. The teacher approaches again, and Laura tells the teacher that there is one task they can't solve. The teacher urges them to turn to each other "*So that you can help Laura and finish this task*" (*"Så att ni kan hjälpa Laura så ni får gjort den här uppgiften."*). The teacher starts to explain; however it seems to me that Laura is the only one who listens. After a while, Lucy comments on the fact that Laura has started to work: "*Well hey there, have you worked ahead of us now?*" (*"Men hallå, har du jobbat ifrån oss nu?"*). Lucy expects them to work as a team while Laura however tries to continue towards her goals. Laura asks the teacher about the very last question on the hand-out that she is working with. Lucy says that they know this already, they do not have to ask about it. But soon it is revealed that this was not true. They could not solve the problem.

Laura's role in the group is emphasised by Carin when during one lesson she says: "*But Lucy, you [pl.] just sit there and Laura is working and you [pl.] just sit there and laugh all the time. Seriously.*" (*"Men Lucy, ni sitter bara och Laura jobbar och ni sitter bara och skrattar hela tiden. Allvar."*) Carin continues her conversation with Matthew while Lucy and the other girls on the desk behind Matthew continue giggling. Carin turns around and approaches them again: "*Do you [pl.] want to do anything? I can help you [pl.] if you [pl.] want? But if you [pl.] don't want to do anything … Shall I help you [sing.] Laura?*" (*"Vill ni göra någonting? Jag kan hjälpa er om ni vill. Men om ni inte vill göra någonting … Ska jag hjälpa dig Laura?"*). Carin gives up on the other girls and instead turns to Laura. In the final grades, Laura is the one that receives best in their group. However, she had to leave her group, following another code and continue by herself trying to reach her goals.

A safe haven
Some groups become extremely tight and strongly classify themselves towards others such as Lucy, Laura and Molly or Rebecca

and Charlotte or Michael and William. This strong classification (Bernstein, 1975) becomes both a shelter for these groups and a power resource where they can achieve their goals and exchange their cultural capital (Bourdieu, 2010). However this is not always according to what the curriculum and pedagogy expects and wants. These groups have created well-classified groups with their unified system of acting and talking. This becomes evident also when an eraser is passed in the classroom. Some girls, Lucy and her friend, do it silently and discretely without any need for instructions or outspoken information or talk between them. The boys, such as Matthew, Nicholas and Joshua, pass it around loudly, throwing it here and there over the classroom. The groups have created their own way of not only talking but acting. In these groups they can probably find other individuals with similar habitus and similar cultural capital that appreciate and value similar things. Instead of being isolated as a lone individual, open for evaluation, the groups work as safe havens where they can support each other's interests, based on similar habitus. They do not need to negotiate themselves towards any social discourses. The group becomes in one way a kind of protection. This is expressed by Molly who states that when she is together with a friend she is not shy and feels safe.

The groups become safe havens for those in similar social class, at the cost of undermining their possibilities. It undermines their possibilities to be fairly evaluated and to have the chance to work with other students who can help them in the educational system. It also undermines Carin's possibilities since she doesn't know about the individual students' abilities. This was clearly expressed at the end of one lesson when Carin says "*That was what this laboratory work should show, James got good results, I don't know about the rest of you*" (*"Det var detta som denna laboration skulle visa, James fick bra resultat, jag vet inte om ni andra.")*. It is probably hard for the teacher distinguish between students in this group; the group becoming the smallest unit and the students adhere to their group at their stationary desks.

The class construction of safe havens in the classroom might just be what we could expect. In a classroom where the students have measured and given each other different positions on the hierarchy scale there is a need for a safe place where the students can find room to manoeuvre and their ways of talking and acting - whatever these may be - are valued. The students have different status or ranking in the groups and this becomes visible when laboratory groups are changed. When Carin rearranges their seating, the student's different status becomes visible. Their safe haven is disturbed. Their status will be clearly visible in the group, open for explicit evaluation by the students and simultaneously visualizing and creating differences and distinctions.

7.5 Concluding "It's a pity you got me"

Laboratory work, the practical component of science education, often focuses on highlighting certain scientific phenomena or concepts and a way of working in science. In this classroom, laboratory work is very common and important, so important that it has its own matrix. Even though the laboratory work has its own matrix, the actual daily activities are often weakly framed (Bernstein, 2000). It is filled with options and room to manoeuvre. It is a chance to work according to your own interests, a chance to discover and investigate scientific phenomena and engage in practical projects in your own pace. These could be lessons filled with curiosity, options and exciting challenges that fulfil curriculum goals and societal expectations. In the end, however, these activities turn out completely differently and not what curriculum, pedagogy or evaluation aimed for.

The effects and the consequences of social class and its relation with the science field and the common way of working there become apparent. When using group work as a method to learn in accordance with the field's doxa and the codes that regulate the classroom, it becomes problematic in many ways. In a science classroom with its premises, its desk, where there is not sufficient laboratory equipment or books, where group work is used explic-

itly or implicitly , this has large implication and works as divider. Carin and the students are not only trapped in colliding codes. The teacher is pinioned by the curriculum and the doxa: she has to lead laboratory work and it has to be in groups, even though evaluation is to be individual. What should Carin do? Carin becomes (or at least tries to become) a translator to twenty students, all of them from different backgrounds, and with different interests and goals. There is a risk that this becomes intolerable and might leave them all blaming themselves for failure.

In this specific way of working and acting, students often work together in groups where they feel safe. These members, in my interpretation, can in many cases be ascribed to the same social class. The group becomes in one way a kind of protection, a safe haven, or a form of power resource where the same resources, possibilities or values can be used, manifested or developed. However, this also implies that what the group becomes, you become. The effects of social class become visible in the group work and this in turn is decisive when looking at achievements. And as Lundqvist (2010) states; "young people participate in a social game with other players on the field" (p. 307), which becomes evident in the laboratory work episodes. What happens in the school science field is not an individual process and cannot be understood as such.

The laboratory work lessons manifest complex interplay between practices and presumptions in the science field, the curriculum, social class, school premises, school doxa and codes. Its collective processes act on the individual student who risks shouldering the burden of blame; *"It's a pity you got me"*.

8. CONCLUSION AND DISCUSSION

8.1 Social class in science class – conclusions

The overall aim of this thesis was to contribute to a more complex and multi-faceted description and analysis of inequalities in education, focusing on social class in the science classroom. This was done through descriptions and analyses of what ways of acting and talking that are valued or not in the science classroom and how these ways of talking and acting can be related to social class. What new knowledge has been produced regarding these aims? What kind of opportunities has this thesis given to be able to "construct empirically grounded and theoretically informed connections" (Power, 1998, p. 25)? There are quite a few threads that could be pulled from the fabric of this research process; some of these will be twisted and turned in this final chapter. However, first this chapter starts with the conclusions of the three result chapters. The conclusions are followed by a discussion.

Conclusion: On the first floor

Unconsciously or not, Carin adapted her teaching to the way the classroom was built. The organization of the premises therefore influenced the organization of the pedagogy and since the classroom was strongly influenced by science and its socio-historical legacy, not only the classroom itself became a prototype of science but the pedagogy. Carin and her students were embedded in science' socio-historical legacy and the influences it had on the pedagogy.

Carin had good intentions; at the same time (or maybe due to her aim) her expectations of the students were low. In a negotiation between expectations, intentions, the student's questions and the discourse that surrounds Westvillage, the knowledge threshold was lowered. Carin's good intentions and presumptions interacted with the classes she had. It changed what was a valid transmission of knowledge for class 8D and what ways of acting and talking that were valued. It created a lowest common denominator, which diverged in relationship to other groups. It was a collective dualistic process that established distinctions in the educational system. What ways of acting and talking that were valued in the science classroom were the effect of complex interplays in a certain field. It could be described as a hidden conciliation where all agents in the field maintained an on-going negotiation. This negotiation not only included the status of the school and its context but the pedagogy and students at the very heart of the classroom activities.

Even though the students were important agents in these negotiations, their backgrounds were in many aspects inaccessible to the educational system. No one expected the students to talk about their backgrounds and traditionally, the school system has blamed (and assessed) the individual students *or* the societal structure for perceived failure. Should we instead be considering the processes and dualistic relationships that actually are responsible for reproducing distinctions and limitations?

Conclusion: "Are you with me?"

Changing ways of talking in this science classroom implied that the students needed to translate what counted as formal educational knowledge on a daily basis. Being able to translate, interpret and adapt to new or changed situations increased the possibilities of understanding what ways of talking and acting that counted as valid or not.

Many of the girls were silent in this classroom and Carin was forced to use tests to assess them. She felt she had to change her pedagogy to adapt to the girls and the curricular demands. It was

therefore not only the girls who needed to interpret, translate and adapt. Carin needed to do the very same thing. Lucy was one of these girls that elucidated what ways of talking that were not valued and how these ways of talking in this science classroom could be related to social class. It happened in an intricate interplay, with hidden negotiations between the practices in the classroom, the teacher and her expectations of the group, in addition to Lucy's low interest in science and the effects of her membership in the group with its social class.

Joshua was another example of the hidden negotiation process. When helping the teacher to maintain the regulative discourse (and sometimes the instructional discourse) by acting as a sounding board, he both influenced and was being influenced by the pedagogy and its code. Together they constructed what ways of talking that were valued and how you could act and talk in a hidden negotiation. The weakly framed dialogues were, like other situations, continuously under negotiation and not something that Carin decided for herself. Rather, it was a permeable and collective process between all the actors in the field (Bourdieu, 1990).

Some students brought into specific dialogues and activities a habitus that could be transformed into cultural capital (here: ways of talking) which gave them advantages. However, it was not their background itself that gave familiarity and in turn advantages. It was in the particular practice and in interplay between the dialogues and the students that this became visible. Social class in the science classroom could be understood and described in the effect of the student's ways of talking and acting when meeting a certain form of communication pattern in a specific situation. In Lucy's case, it was the membership of a specific social class-group and the effect it exerted on its members (Bourdieu 2010) that was relevant when understanding social class in the classroom rather than a cause and effect relationship between social class and science subjects.

At first sight the weakly framed dialogues, where Joshua and the others functioned as sounding boards, entailed options and freedom. However, it was freedom for few (foremost Joshua, Matthew and Nicholas). In strongly controlled dialogues, more students could be heard and evaluated. The question remains, however if this really gave larger possibilities for room to manoeuvre or if it is a chimera? Even though Carin gave the silent students a chance to let their voices be heard, the argumentation and the complexity of the dialogues and the scientific content were narrowed.

Nylund and Rosvall (2011) stated that vertical discourses in the classroom give power and have potential to question existing circumstances since it gives possibilities and access to think outside the context, outside the box. However, in this classroom, horizontal discourse was used often. Since some students often met everyday knowledge only in school they were not given access to the vertical discourses that would have given them possibilities to break the uneven distribution of knowledge and power in the education system and society. It became a dialogue and a discourse based on the lowest common denominator that in the long term will exclude some students, since their spielraum actually was narrowed. However, all students in the classroom were suffering under this discourse since Carin negotiated and adapted her pedagogy and expectations of the group. Therefore, there were consequences not only for different groups of students but for *all* the students in the context. Forms of knowledge in the classroom concern all students in a classroom.

The science dialogues were not simple communications from one party to another, neither did they focus on content and introducing certain scientific knowledge. It was rather a game the students and the teacher needed to understand, translate and interpret. It was not the student's background itself that gave familiarity and in turn advantages. It was in the particular practice and in interplay between the dialogues and the students that this became visible. It was in the effect of the student's ways of talking and acting when meeting a certain form of communication pattern in a specific

situation that social class in the science class could be understood and described. For example, what became valid transmission of knowledge was therefore not only up to Carin and her pedagogy, neither was it a question of a specific socioeconomic background. It was not only the students that needed to engage, participate or pick up cues.

Conclusion: "It's a pity you got me"

Laboratory work lessons should be filled with curiosity, freedom and exciting challenges. And Carin provided the students with these opportunities in this common way of working in 8D's classroom. In the end, these activities produced completely different results.

In the science dialogues as well as in the laboratory work, it was the organisation of content rather than the content itself that was important. The regulative discourse totally overruled the instructional discourse and became the most important and decisive factor in this practical science activity. In a subject strongly influenced by its socio-historical legacy with facts, figures and non-negotiable knowledge, it was not the content that was decisive for the students. Therefore, those students that had cultural capital that gave value to or could be exchanged in the regulative discourse had better chances. Educational success in the school science field seems dependent not only on content but also on familiarity with ways of talking and communicating (Lemke, 1990).

There was nothing that caused so many outspoken feelings in the classroom than the group processes and most of all, the rearranging of the groups. The students and the teacher constructed each other in different social classes depending on their social rank. The effects of this hierarchical class marking process became decisive in this common activity in this classroom. What became problematic with the laboratory group tasks was not only the social discourse and ranking. In addition and in correlation with this, there are colliding codes in the classroom. The evaluation in the Swedish school is individual, however, the doxa, the unconscious values and pre-

suppositions of the science field (Bourdieu, 1992), that strongly influenced this classroom entailed that the students worked in teams or in pairs. There were doxa operating in the science education field regarding the way the classroom was built and the way laboratory work is often performed that presupposed group work. However, the regulative principle (Bernstein, 1975) worked towards an evaluation that was individual. In other words, in order to get good grades it was better to work by yourself. If being properly evaluated according to the matrixes, the students had to resist working in teams. The doxa expected cooperation and a code that rewarded individuality. In addition, it was not only doxa in this classroom that stated that you should work in teams, it was written in the curriculum, e.g. a regulative principle, a code. There were at least two parallel and colliding codes in the curriculum and the classroom. Bernstein (1975) noted: "Curriculum defines what counts as valid knowledge, pedagogy defines what counts as valid transmission of knowledge, and evaluation defines what counts as a valid realization of the knowledge on the part of the taught" (p. 85). In laboratory group work the pedagogy and curriculum was in conflict with the evaluation. Neither the teachers nor the students had a fair chance to manoeuvre and to decipher what code that counted as valid realization. Adding this to the evaluation process with individual grades, it became hard for the students to understand what rules were needed. Besides that, the teacher Carin had to decipher the curriculum and in addition take into account the socio-historical legacies of science education with its doxa. Those students who could interpret what was valued and when had greater possibility of success either by seeing what to do and supporting the others in the group or by resisting the group when necessary. A student (or a teacher) that could deal with this conflicting information and could make a decision and make the distinction between what code to follow in different episodes, could also make successful choices: they could do the right thing at the right time.

The students worked together in groups, which according to my analyses, in many cases was built upon a membership ascribed to the same social class. The groups became safe havens for those in a

similar social class, while at the same time undermining their possibility of being fairly evaluated and having the chance to work with other students that could help them in the educational system. And this might be expected, in a classroom where the students had measured each other and given each other different positions in the hierarchy. There was a need for a safe place where the students could find room to manoeuvre, where their ways of talking and acting were valued. The groups became their important playing grounds and became decisive when it came to how they should act and what was valued and not. The students had different status or rank in the group and this became visible when the orders of the groups were disturbed. The group became in one way a kind of protection. However, this also implied that what the group becomes, you become. It was therefore the effects of social class that became visible in the group work and this in turn was decisive when looking at achievements. As Lundqvist (2010) states: "Young people participate in a social game with other players on the field" (p. 307). What happened in the school science field was not an individual process. It was the effect of social class, i.e. the effect of feeling safe with others with similar upbringing. Since group activities are such a common way to work in this science classroom, social class had large implications in this science class.

The effects and the consequences of social class and its relation with the science field in this common way of working was apparent when using group work as a method to learn (always with the best of intentions and in accordance with the doxa in the field and sometimes with the code). These should be lessons filled with curiosity, freedom and exciting challenges. The result was completely different. In a science classroom with its premises, its desk, where there were not sufficient equipment or books, where group work explicitly or implicitly was used, this activity worked more as a divider and excluder rather than the opposite. Carin and the students were not only trapped in colliding codes. The teacher and students were pinioned by the curriculum and the doxa, they had to perform laboratory work and it had to be in groups, however evalua-

tion is always individual. What should they do? Laboratory work became something extremely complicated.

The laboratory work left the students blaming themselves the way Lemke (1990) feared the student would in the science classroom. This happened even though this was the outcome of complex interplay between practices and presumptions in the science field, the curriculum, social class, school premises, school doxa and codes.

8.2 Back to the point of departure

This research process began with several questions such as: Could there be other explanations for failure other than intelligence and talent? Was there something else going on, a game or a process outside the student that needed attention when discussing success? Lemke (1990), another science educational researcher, writes that "the basic point-of-view is that science is a social process" (p. xi). What kind of consequences might that have in the science classroom? What if it all is a social process? What if we need to find other explanations than to "individualise failures and legitimise inequalities within structure where failure is attributed to inborn facilities" (p. 146)? Beginning with these questions I turned first to earlier statistical research and reports. The process continued with definitions and limitations and the science education field was characterised. The research process proceeded with the theoretical framework and research questions were formed. They were examined from theoretical perspectives and empirically-produced knowledge. Did I find answers? Yes, I found some; however new questions have been raised and there are many reasons to continue the research process and the discussion that this thesis started. Nevertheless there are some things that have surprised me more than other things. I want to emphasise three.

Firstly, what surprised me were the strong advantages of working as closely as I did with theoretical framework. It has been essential when keeping track, deepening and assisting in descriptions as well as in analysis. One good example is the field concept (Bourdieu

and Waquant, 1992) which has been a helpful tool in bringing forward and seeing science education as a field and in turn studying the doxa (Bourdieu, 1992) in the field. Without this perspective, I could not have understood the importance of school science as a prototype of science (Carlone, 2003, 2004) in this research process. This in turn helped to show that it is not science education itself that causes discriminatory reproduction patterns, but rather the effects of the socio-historical legacy of science. Carlone exemplifies: "There is a lot of baggage associated with what makes a 'good' science education, including socially constructed notions about what science is, who does science, what belongs in the science curriculum, and how best to 'deliver' the content" (Carlone, 2003, p. 308). What this baggage did in the classroom - often through hidden curricula and taken for granted activities - surprised me deeply. For example, given that the pedagogy and the code in the classroom is influenced by the socio-historical legacy of science and built up as a prototype of science, I claim that strong consideration must be given regarding what a specific context causes and demands, and take into account how the socio-historical legitimised practices and activities are enacted in the classroom.

Secondly, I want bring forward the descriptions and analyses of the students. In the first result chapter we met: Joshua – doing the right thing; Lucy - "with you or not?"; Matthew – happy and humorous; Liam – "penalty point"; Rebecca - unfair in pairs; Laura - shy and quiet; Nicholas -"kind of smart". There was a risk when describing and analysing the students that too much focus on the individual student could cause deterministic interpretation. However, I claim that through the individual students it has been possible to see how societal discriminatory structures - often are talked about on a general level in society - directly influence the everyday life in the classroom and act upon the individual student. Nevertheless, stating this, social class and the different individual students must be understood in their context and in dualistic, negotiative processes. Social class can be more or less created and manifested, however social class is clearly manifested and created in some of the ac-

tivities that we use in science classrooms, such as in the dialogues or in the laboratory work which is always performed in groups. According to Bourdieu (2010), social class is defined by the network of relations between all its properties or characteristics. This network must be seen in the light of a specific practice and what is valued there (seen for example through the socio-historical "lens"), and in addition, the effects of this. Social class does not only give us answers. The science field must be taken into account. This might be one of the things that surprised me the most: that the individual students and his or hers background or possible talent really did not stand out. Failure in classroom could not be correlated to innate skill (Lemke, 1990) per se. One example was Liam. Being talented in the science classroom means having a feel for the game and what is going on, what is valued, when and how? Science learning and teaching is a social process (Lemke, 1990). I had a presumption of a dualistic process, but I could not imagine that it was so visible, strong and filled with negotiations. In this classroom two perspectives of class are encountered. I claim that science in itself brings in a class perspective. This encounter emphasises that science class also versus social class. Social class in science class could and should be interpreted in at least two different ways.

Thirdly, what surprised me was how the scientific content was used and realised. In the interwoven relationships, the dualistic processes, it seems as though when coming to understand, translate and interpret the content, it was rather the form of the content and the way the content was represented that was important. The instructional discourse, the transmission of knowledge - in this case, the scientific content - was outmanoeuvred by the regulative discourse. The form, the way it was presented, was more important to the students than the understanding of the content. What also should be emphasised was that the knowledge level in this classroom was lowered. In hidden negotiation between the teacher's expectation, the socio-historical legacy of science and students' presumptions, the pedagogy changed. The questions became simpler, the forms of assessment changed. This was done with good intentions and probably with the "weak" students in mind. How-

ever, all students in the classroom suffered from this imposition of the lowest common denominator of knowledge, since science learning is such a social process. This entails that if the knowledge threshold is to be lifted in a classroom, there must be a sharper focus not on the individuals such as students or teacher, but rather on the hidden negotiations that lowers the level.

8.3 (Class)room

A number of results have surprised me deeply and raise new (?) questions: Are there classrooms for all students? Are there rooms for children from all different classes? Should there be? What would they look like? What should be changed?

I claim that if we want change, it is possible. A number of researchers have put forward that science education reproduces inequalities. So what to do with science education if we want change and a classroom for all? I claim it is not science education in itself that reproduces inequalities, it is the way it has been constructed by society and the way it has constructed itself. In other words, it is not the specific content, what kind of figures and facts, but rather what kind of legacy, what kind of values that science education carries. I claim that this perspective, though deeply problematic, powerful and strongly positioned in society, actually makes way for equality and possibility. Examining further this baggage, surprisingly tangible, would be one interesting, important and fruitful future research project.

Dealing with class and reproduction issues is sometimes heavy, deterministic and might just reproduce another dark picture. However, the notion of social class always brings in the specific context of a playing field. Using the notion that social class concerns recognizing the student's situation and context, I want to maintain that this is not deterministic and dark, but rather the opposite. As much as distinctions and limitations are created in specific situations and practices, I claim that it is exactly there that possibilities and room to manoeuvre can be found. The fact that the students

must be seen and recognized in their context, from their perspective, gives the picture other colours and more depth. It is in this context that the students can be recognized (Carlone and Johnson, 2007), important for their path and dispositions into the future.

However, this focus on the context and the specific field challenges the education system. It challenges the thought that all students in all schools in a country should gain and obtain the very same universal (or at least national) predetermined knowledge directed by for example curriculum and/or socio-historical legacies. If students possibilities, their success and their room to manoeuvre should be understood and recognized in a specific context in a certain field – how can we - for example - assess students equally? Recalling that assessment actually provides the admission ticket to their future: can students be equally assessed? Should they? By whom? When? How can we relate the individual student and his or her possibilities, options, cultural capital, habitus, room to manoeuvre and so forth to national, universal criteria and in addition to desirable societal values?

I claim this is a societal educational paradox that is enacted every day in every classroom, leaving students and teachers at the crossroad where the one and only cultural capital and habitus become important: the cultural capital that is so decisive in education and especially in science. Otherwise, how can it be that, according to Jonathan Chait (2011, November 7) poor kids in America (and I claim elsewhere) "who succeed academically are less likely to graduate from college than richer kids that do worse in school … Even if they graduate from college the children of the poor are still worse-off than low-achieving children of the rich?". The Swedish curriculum stipulates that

> education in the school system aims at pupils acquiring and developing knowledge and values. It should promote the development and learning of all pupils, and a lifelong desire to learn. … The inviolability of human life, individual freedom and integrity, the equal value of all people, equality between women and men, and solidarity with the weak and vulnerable are the values that the school should represent and impart. … The task

of the school is to encourage all pupils to discover their own uniquals as individuals and thereby be able to participate in the life of society by giving of their best in responsible freedom (p. 9).

I assert this is a chimera of freedom. What does freedom entail in the classroom? The students in 8D are given a lot of options and possibilities. But this does not automatically give freedom. There are not many students that can make use of this freedom, neither take it nor claim it. The recipient of the Nobel Memorial Prize in Economic Sciences 2001, Joseph E Stiglitz, states when discussing inequality and economics that "real democracy is more than the right to vote once every two or four years. The choices have to be meaningful" (Stiglitz, 2012, p. 17). Carlone et al (2011) states

An equitable science classroom, then, cannot be defined with the criterion that everyone has the chance to learn when the opportunity presents itself. Instead, our study implies that an equitable classroom is where all students are entitled, expected, and obligated to participate competently (p. 481).

Therefore, we fool ourselves thinking of the science classroom as a place for individual freedom. If we are not willing to acknowledge the paradoxes and the hidden negotiations, we might be hindered in looking upon or acknowledging important collective processes that we all gain from. There is a need to challenge the relations between individual freedom, opportunities and equality. Stiglitz states that "this decline in opportunity has gone hand in hand with our growing inequality. In fact, that pattern has been observed across countries – countries with more inequality systematically have less of opportunity" (Stiglitz, 2012, p. 39). When increasing options and freedom without bringing into the discussion collective processes and thus educational paradoxes, this means somebody else or something else takes control and the students end up doing what is familiar and known. At its most basic point, science education and "freedom is not something given: it is something you conquer – collectively" (Bourdieu, 1990, p. 15).

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APPENDICES

Appendix A Letter to parents

Hej!

Jag heter Anna Jobér och arbetar som doktorand på Lärarutbildningen på Malmö högskola.

Under början av vårterminen kommer jag att genomföra en studie i klassen och finnas med på alla NO-lektioner samt under vissa mentorstider. Jag kommer att genomföra intervjuer och observationer samt även göra ljudinspelningar. Enligt elevernas önskemål så kommer jag inte att genomföra några videoinspelningar. För att kunna genomföra denna studie behöver jag få ditt godkännande som förälder/vårdnadshavare. Ditt barn, klassen och skolan kommer att vara anonyma i min studie och allt material kommer att behandlas konfidentiellt. Mitt syfte med min forskning är att undersöka vilka faktorer i klassrummet som påverkar studieresultatet i NO och min förhoppning är att jag genom denna studie kan bidra till en ökad förståelse om barns lärande i naturvetenskap. Om du vill fråga om någonting får du gärna höra av dig till mig! Du når mig lättast på telefonnummer 040-665 80 14 eller på min mail anna.jober@mah.se.

Med vänlig hälsning
Anna Jobér

✂ ....
Vänligen sätt ett kryss i någon av rutorna nedan och skicka sedan tillbaka lappen påskriven till ditt barns mentor. Svar önskas snarast!

☐ Ja, mitt barn får vara med i studien.
☐ Nej, jag vill inte att mitt barn ska vara med i studien.

Mitt barn heter: _____
Underskrift målsman: _____
Namnförtydligande:_____

Appendix B Letter to students

MALMÖ HÖGSKOLA

Hej!

Jag heter Anna Jobér och arbetar som doktorand på Lärarutbildningen på Malmö högskola.

Under början av vårterminen kommer jag att genomföra en studie i klassen och finnas med på alla NO-lektioner samt under vissa mentorstider. Jag kommer att genomföra intervjuer och observationer samt även göra ljud- och eventuellt videoinspelningar.

För att kunna genomföra denna studie behöver jag få ditt samtycke. Du, din klass, din skola och din lärare kommer att vara anonyma i min studie och allt material kommer att behandlas konfidentiellt.

Om du vill fråga om någonting får du gärna höra av dig till mig! Du når mig lättast på telefonnummer 040-665 80 14 eller på min mail anna.jober@mah.se.

Med vänlig hälsning

Anna Jobér

Vänligen sätt ett kryss i någon av rutorna nedan! Vik ihop lappen och lämna till mig. Om du inte vill vara med behöver du inte lämna in någon lapp. Svar önskas senast 1:e februari.

☐ Ja, jag vill vara med i studien.
☐ Ja, jag vill vara med i studien, men jag vill inte bli filmad.

Underskrift:
_____
Namnförtydligande:
_____
Vik ihop lappen och lämna till mig! Tack!

Appendix C Observation scheme and Observation guide

Datum		Tid	
Typ av lektion			
Inspelning			
Möblering			
Tavla eller likn.			
Arbetssätt			
Materiel			
Övrigt			

Fältanteckningar:

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………… etc.

Observation guide

Mål och förkunskaper
Hur tar läraren reda på vad eleverna kan innan? Hur utnyttjas elevernas erfarenheter? Hur blir undervisningens mål och plan tydligt?

Tal- och rumsutrymme
Vem får bidra med sin erfarenhet? Vem ställer frågor? Hur cirkulerar läraren i klassrummet? Vilka får svar? Vilka svarar? Vilket språk används? Vem väljs ut? Vilket spelutrymme? Samtal: interaktiva, dialogiska?

Relationer
Samspel lärare-elev. Samspel elev-elev. Samspel elev-dator/mobil. Hur sker samspelet? Gester, blickar, tal?

<u>Undervisningens innehåll, gestaltning</u>
Abstrakt-konkret/komplexitet? Hur skiftar detta? Vilka nivåer halls undervisningen på? G, VG eller MVG? Hur lägger man upp undervisningen (grupparbete, enskilt, par) Läxor. Hur mycket? Hur kontrolleras de? Hurmycket kontrolleras de? Läromedel, vilka och hur används de och av vilka elever? Laborationer, vilka och hur används de och av vilka elever? Hjälpmedel, vilka och hur används de och av vilka elever? Vilka läromedel/laborationer/hjälpmedel väljs bort? Hur definieras området? Definieras det som viktigt När i de olika momenten tycks eleverna känna sig bekväma/obekväma?

<u>Bedömning av elever</u>
Vem får beröm? Vem får klander? Vem väljs ut? Vad bedöms, hur bedöms det (formativ, summativ)? Uttrycks betyg och bedömning som bruksvärde eller bytesvärde?

<u>Trivsel och vantrivsel</u>
Vad iscensätter eleverna sig själva i för situation (vetenskapsman, hjälpreda)? När trivs eleverna, när uttrycker de vantrivsel, passivitet? När spricker fasaden, när blir eleven osäker? Varför den blir det just då/tillfällen av osäkerhet? När uppstår en handling som visar att man har/inte har känsla för situationen? Känslouttryck.

<u>Critical incidents</u>
När frångår man sina mönster, när gör man något som visar på något annorlunda? Måste se det vanliga först? Fråga läraren när det händer något ovanligt, vad hon anser vara ovanligt?

<u>Mönster och strukturer</u>
Vilka dolda finns det? Och hur korrelerar de med varann?

Appendix D Interview guide students

Intresse: Hur skulle du beskriva ditt intresse för NO i skolan? Och utanför skolan (TV, fritid, spel)?

Lärande, kunskap, begriplighet: Kan du berätta för mig hur du lär dig något! När är det lätt/svårt? Varför tror du att du känner så? Hur går det till? När du läser, genomgångar, laborationer, grupparbeten?
Vad gör du om du inte förstår på en lektion? Vad gör du om du inte förstår hemma?

I jämförelse med andra ämnen: Om du skulle jämföra NO med andra ämnen, vad är de stora skillnaderna enligt dig? Böcker, material, innehåll, undervisnings upplägg, lärare?

Specifikt område (mekanik): innehåll, gestaltning, mål: Vad är mekanik för dig? Vad kände du till om mekanik innan? Vad tänker du om det material ni använder i detta område? Böcker, hjälpmedel etc. Hur tycker du man ska göra för att lära sig mekanik? Om du vore lärare, hur skulle du undervisa? Vad tror du målet är med området mekanik?

Språk: Vilket språk skulle du vilja ha NO på? Varför? Vad tycker du om språket … i böcker, på stenciler, när läraren pratar, på laborationer? Lätt, svårt? Varför?

Läxor: Kan du berätta för mig hur det brukar gå till om och när du gör NO-läxor hemma!
Vem hjälper dig? Hur mycket tid per vecka? Vad gör du om du inte förstår? Lätt/svårt? Om du fick välja helt fritt hur du skulle vilja ha det med läxor i NO, hur skulle det vara då? Vilket ämne brukar du jobba med mest hemma? Vilket språk använder ni när ni gör läxor hemma? Är det olika i olika ämnen?

Förväntningar: Vilka förväntningar har du på dig själv i NO? Vilka förväntningar tror du andra har på dig?

Betyg och bedömning: Kan du berätta vad betygen innebär för dig? Viktiga? Viktiga för vad? Vad innebär ett bra/dåligt betyg för dig? Vad vill du använda dina betyg till? Är det något som motiverar dig till att få ett bra betyg? Känner du att din kunskap blir bedömd som du tänker dig det? Kan du berätta om ditt NO-betyg! Brukar du lyckas eller misslyckas i NO sett från ditt perspektiv? Tycker du att du blir rättvist bedömd? I relation till andra? Vad hoppas du om ditt nästa betyg?

Relationer: Hur skulle du beskriva din relation till din NO-lärare? Hur skulle du beskriva din relation till dina klasskompisar på NO-lektionerna? Vad betyder de för ditt lärande tror du? Gör de det enklare eller svårare?

Familjen och NO: Pratar ni om NO hemma? Vad tror du dina föräldrar tänker om NO? Vad tänker dina syskon om NO? Jämfört med andra ämnen?

Sätt eleven i olika scenarier (ev): Om du fick vara lärare, hur skulle du göra för att lära eleverna ex. mekanik eller optik? Om du fick bestämma själv hur du skulle vilja ha en lektion i mekanik, vad skulle du göra då? Varför?

2. Framtid, utbildning, yrke
Vad tror du att du kommer att göra/arbeta med i framtiden? Yrke? Varför?
Vad tror du dina föräldrar tänker om din framtid? Vilket yrke, tror du, de vill du ska ha? Varför? Vilken roll spelar skolan för din framtid? Vilken roll spelar NO (betyg, undervisning, intresse) för din framtid?

3. Familjen, bakgrund (flertalet frågor behandlas även i PISA-enkäten!)
Hur lång tid har du bott i Sverige? I vilken årskurs började du skolan i Sverige?
Vilka språk talar du? Vilket språk tycker du att du talar bäst? Vilket språk talar du helst? I skolan och hemma? Vilket språk tänker du på? I skolan och hemma? Vad tänker du omkring detta? Om du fick välja vilket språk du skulle använda i skolan, vilket skulle du då välja? Varför? Har du eller har haft någon modersmålsundervisning?
Kan du berätta om din familj? Bor du tillsammans med dina föräldrar? Syskon? Var bor ni? Trivs du där? Har du bott någon annanstans?
Kan du berätta om dina föräldrar! Hur länge har dina föräldrar bott i Sverige? Vad arbetar dina föräldrar med? Vad har dina föräldrar för utbildning?
Vad brukar ni göra hemma i er familj? TV, läsa, fritidsaktiviteter?
Vad tror du de tycker om skolan?

4. Elevens intressen, personlighet och framtidsplaner
Kan du beskriva dig själv och vem du är?
Har du några förebilder, någon du skulle vilja vara eller vara som? Någon/något du identifierar dig med?
Vad är din talang? Vad är du bra på? Varför?
Fritidsintressen? Vad gör du (helst) när du är ledig? Fritidsintressen bakåt, förr i tiden?
Vad vill du göra/arbeta med när du blir stor? Livsprojekt?
Vad betyder skolan för dig? Vad betyder skolan och att studera för vad du vill göra i framtiden? Är skolan viktig för att du ska nå dit du vill/dina mål?

Appendix E Interview guide teacher

Yrke och bakgrund:
Utbildning, erfarenhet, förväntningar

Din NO-undervisning:
Vad gör du om en elev inte förstår på en lektion?

Hur tänker du när du planerar ett område som fysik och mekanik? Bedömning, organisation, hjälpmedel? Hur ser du på det material ni använder? Laborationer, böcker? I relation till skolplaner och läroplaner? I relation till det omgivande samhället? Intentioner/mål/med undervisningen (i detta specifika område men också generellt)? Vad ser du som de viktigaste målen med detta avsnitt och mer generellt med NO? Hur bär du dig åt för att komma dit?
Är det något speciellt med ämnena fysik och mekanik om man jämför med andra delar i NO-undervisningen?

Vilken roll spelar läxorna?

Bedömning, hur ser du på det? Hur resonerar du när och hur du bedömer eleverna? Svårigheter? Vad innebär betygen? Känner du att du har tillräckligt på fötterna när du sätter betyg? Brukar de kännas rättvisa?

Denna klass:
Är det något speciellt med denna klass och hur påverkar det dig som lärare? Jämförelse med andra klasser? Hur ser du på deras förutsättningar? Hur skulle du beskriva relationerna med eleverna? Relationer i klassen, relationen till klassen? Intentioner/mål med undervisningen i denna klass? Undervisningens innehåll och gestaltning för denna klass? Vad gillar denna klass? Vem är det som bestämmer av eleverna och får mest utrymme?

Framtid
Vad tror du om elevernas framtid? Vilka tror du kommer att arbeta med något som har en naturvetenskaplig framtid?
Vilken roll tror du föräldrarna spelar för elevernas framtid?
Vilken roll tror du, du, NO-undervisningen spelar?
Vad tror du skolan spelar för roll i elevernas livsprojekt?

Elevens bakgrund
Vilken roll tror du elevens bakgrund spelar (ex. socioekonomisk, föräldrars utbildning) för resultat, betyg, prestation? Vad tänker du om orsakerna bakom elevernas olika resultat?
Vilken roll spelar det att vara pojke eller flicka i klassen?

Appendix F Questionnaire

Based on PISA 2006 (OECD, 2007).

Q1. När är du född?
(Skriv månad och år när du är född)
_____ 19 ____
Månad   År

Q2. Är du flicka eller pojke?
     Flicka   Pojke

Q3. Vilket är din mammas huvudsakliga arbete? (t ex lärare, köksbiträde, försäljningschef)
(Om hon inte arbetar nu, skriv vad hon arbetade med senast.)

Skriv vad hennes yrke kallas. _____

Q4. Vad gör din mamma i sitt huvudsakliga arbete? (t ex undervisar grundskoleelever, hjälper kocken att laga mat på en restaurang, är chef för en grupp försäljare)
Beskriv med en mening vad hon gör eller gjorde i sitt arbete.
_____

Q5. Vilken är den högsta utbildning av nedanstående som din mamma har slutfört?
Om du inte är säker på vilken ruta du ska kryssa i så be provledaren om hjälp.
(Sätt bara kryss i en ruta)
a)   Tre- eller fyraårig teoretisk gymnasieutbildning
b)   Tvåårig gymnasieutbildning
c)   Nioårig grundskola
d)   Sex år i grundskola
e)   Hon har gått mindre än 6 år i grundskola

Q6. Har din mamma genomgått och slutfört någon av följande utbildningar?
Om du inte är säker på vilken ruta du ska kryssa i så be provledaren om hjälp.
(Sätt kryss i en ruta på varje rad)
                                                                              Ja   Nej
a) Universitets- eller högskoleutbildning omfattande minst 3 år
   (t ex fil.kand.-, fil. mag.-, fil.lic.- eller fil.dr.-examen)
b) Universitets- eller högskoleutbildning omfattande mindre än 3 år

Q7. Vilket är din pappas huvudsakliga arbete? (t ex lärare, köksbiträde, försäljningschef)
(Om han inte arbetar nu skriv vad han arbetade med senast.)

Skriv vad hans yrke kallas. _____

Q8. Vad gör din pappa i sitt huvudsakliga arbete? (t ex undervisar grund-skoleelever, hjälper kocken att laga mat på en restaurang, är chef för en grupp försäljare)

Beskriv med en mening vad han gör eller gjorde i sitt arbete.

_____

Q9. Vilken är den högsta utbildning av nedanstående som din pappa har slutfört?

(Sätt bara kryss i en ruta)

a)   Tre- eller fyraårig teoretisk gymnasieutbildning
b)   Tvåårig gymnasieutbildning
c)   Nioårig grundskola
d)   Sex år i grundskola
e)   Han har gått mindre än 6 år i grundskola

Q10. Har din pappa genomgått och slutfört någon/några av följande ut-bildningar?

(Sätt kryss i en ruta på varje rad)

                                                                    Ja   Nej

a) Universitets- eller högskoleutbildning omfattande minst 3 år
   (t ex fil.kand.-, fil. mag.-, fil.lic.- eller fil.dr.-examen)
b) Universitets- eller högskoleutbildning omfattande mindre än 3 år

Q11. Om du INTE är född i Sverige, hur gammal var du när du kom till Sverige?

(Om du var yngre än 12 månader gammal, skriv noll (0))
_____   År

Q12. Vilket språk talar du oftast hemma?

(Sätt bara kryss i en ruta)
        Svenska
        Arabiska
        Finska
        Spanska
        Annat språk

Q13. Vad, av det som står nedanför, finns hemma hos dig?

(Sätt kryss i en ruta på varje rad)

                                                                    Ja   Nej

a)   Ett skrivbord för studier
b)   Ett eget rum
c)   En lugn plats för studier
d)   En dator som du kan använda för ditt skolarbete
e)   Dataprogram för inlärning/utbildning
f)   Internetuppkoppling
g)   Egen räknare
h)   Klassisk litteratur (t ex Strindberg)
i)   Poesiböcker

j)   Konstverk (t ex målningar)
k)   Böcker du kan ha hjälp av i ditt skolarbete
l)   Ett lexikon/en ordbok
m)   En diskmaskin
n)   En DVD-spelare eller video
o)   Piano
p)   Videokamera
q)   Vägg-TV

Q14. Hur många av dessa saker finns hemma hos dig?
(Sätt bara kryss i en ruta på varje rad)

	Ingen	En	Två	Tre eller fler
a) Mobiltelefon				
b) TV				
c) Dator				
d) Bil				
e) Badrum eller duschrum				

Q15. Spelar du något intrument?
Ja   Nej

Q16. Om ja, vilket?
_____

Q17. Ungefär hur många timmar per vecka spelar du detta instrument?
0-10 timmar
11-20 timmar
21 timmar eller mer

Q18. Hur många böcker finns det hemma hos dig?
Det finns vanligen ungefär 40 böcker på en hyllmeter. Ta inte med tidskrifter, dagstidningar eller dina läroböcker. (Sätt bara kryss i en ruta)

0-10 böcker
11-25 böcker
26-100 böcker
101-200 böcker
201-500 böcker
Mer än 500 böcker

Q19. I vilken grad håller du med om följande påståenden?
(Sätt bara kryss i en ruta på varje rad)
Svarsalternativ: Håller absolut med, håller med, håller inte med, håller absolut inte med
a)   Jag tycker för det mesta att det är roligt att lära mig saker inom natur-
        vetenskap
b)   Jag tycker om att läsa om naturvetenskap
c)   Jag blir glad av att ägna mig åt naturvetenskapliga uppgifter

d) Jag gillar att skaffa mig nya kunskaper i naturvetenskap
e) Jag är intresserad av att lära mig om naturvetenskap

Q20. I vilken grad håller du med om följande påståenden?
(Sätt bara kryss i en ruta på varje rad)
Svarsalternativ: Håller absolut med, håller med, håller inte med, håller absolut inte med

a) Framsteg inom naturvetenskap och teknik förbättrar i allmänhet människors levnadsförhållanden
b) Naturvetenskap är viktigt för att hjälpa oss förstå världen omkring oss
c) Vissa begrepp inom naturvetenskap kan hjälpa mig förstå hur jag står i förhållande till andra människor
d) Framsteg inom naturvetenskap och teknik bidrar i allmänhet till att förbättra ekonomin
e) Jag kommer att använda naturvetenskap på många sätt när jag blir vuxen
f) Naturvetenskap är värdefullt för samhället
g) Naturvetenskap är mycket betydelsefullt för mig
h) Jag tycker att naturvetenskap hjälper mig förstå saker omkring mig
i) Framsteg inom naturvetenskap och teknik medför i allmänhet sociala fördelar
j) När jag gått ut skolan kommer det att finnas många möjligheter för mig att använda mig av naturvetenskap

Q21. Hur ofta gör du det här?
(Sätt bara kryss i en ruta på varje rad)
Svarsalternativ: Mycket ofta, regelbundet, ibland, aldrig eller nästan aldrig

a) Tittar på TV-program om naturvetenskap
b) Lånar eller köper böcker om naturvetenskap
c) Besöker webbsidor som handlar om naturvetenskapliga ämnen
d) Lyssnar på radioprogram om framsteg inom naturvetenskapen
e) Läser naturvetenskapliga tidskrifter eller artiklar om vetenskap i tidningar
f) Besöker en naturvetenskaplig förening

Q22. Här är en lista på naturvetenskapliga ämnesområden. Varifrån har du huvudsakligen lärt dig något om vart och ett av dessa områden?
(Sätt kryss i så många rutor som behövs på varje rad)
Svarsalternativ: Inget av alternativen, jag är inte säker på vad det är, skolan, TV, radio, tidningar, tidskrifter, mina vänner, familjen, internet eller böcker

a) Fotosyntes
b) Kontinenternas uppkomst
c) Gener och kromosomer
d) Ljudisolering
e) Klimatförändringar
f) Evolution
g) Kärnkraft
h) Hälsa och närings-lära

Q 23. I vilken grad håller du med om nedanstående påståenden?
(Sätt bara kryss i en ruta på varje rad)
Svarsalternativ: Håller absolut med, håller med, håller inte med, håller absolut inte med

a) Jag skulle vilja arbeta med ett yrke som har med naturvetenskap att göra
b) Jag skulle vilja läsa naturvetenskap efter gymnasiet
c) Jag skulle vilja ägna mitt liv åt att syssla med avancerad naturvetenskap
d) Jag skulle vilja arbeta med naturvetenskapliga projekt när jag blir vuxen

Q 24 I vilken grad håller du med om nedanstående påståenden?
(Sätt bara kryss i en ruta på varje rad)
Svarsalternativ: Håller absolut med, håller med, håller inte med, håller absolut inte med

a) Det är värt mödan om jag anstränger mig i NO-ämnena för det kommer att vara mig till hjälp i det jag vill arbeta med senare
b) Det jag lär mig i NO-ämnena är viktigt för mig därför att jag behöver det när jag vill studera vidare senare
c) Jag läser NO för att jag vet att jag kommer att ha nytta av det
d) Studiet av NO-ämnen är av värde för mig, för det jag lär mig kommer att förbättra mina yrkesmöjligheter
e) Jag kommer att lära mig mycket i NO-ämnena som blir till nytta när jag ska skaffa jobb

Q 25. Följande fråga handlar om dina erfarenheter av att lära dig NO-ämnen.
I vilken grad håller du med om nedanstående påståenden? (Sätt bara kryss i en ruta på varje rad)
Svarsalternativ: Håller absolut med, håller med, håller inte med, håller absolut inte med

a) Jag skulle ha lätt för att lära mig avancerade NO-ämnen
b) Jag kan för det mesta ge bra svar på provuppgifter i NO-ämnen
c) Jag lär mig NO-ämnen snabbt
d) NO-ämnen är lätta för mig
e) När jag får undervisning i NO har jag väldigt lätt för att förstå begreppen
f) Jag har lätt för att förstå nya idéer inom NO

Q 26. Hur mycket tid använder du normalt per vecka för att studera följande ämnen?
En timme betyder här 60 minuter, inte en lektion. (Sätt bara kryss i en ruta på varje rad)
Svarsalternativ: Ingen tid alls, mindre än 2 timmar i veckan, mellan 2 och 4 timmar i veckan, mellan 4 och 6 timmar i veckan, 6 timmar eller mer i veckan
NO-ämnen

a) Vanliga lektioner i skolan i NO
b) Lektioner utanför skoltid i NO
c) Plugga eller göra läxor i NO på egen hand

Matematik
d)   Vanliga lektioner i skolan i matematik
e)   Lektioner utanför skoltid i matematik
f)   Plugga eller göra läxor i matematik på egen hand

Svenska
g)   Vanliga lektioner i skolan i svenska
h)   Lektioner utanför skoltid i svenska
i)   Plugga eller göra läxor i svenska på egen hand

Andra ämnen
j)   Vanliga lektioner i skolan i andra ämnen
k)   Lektioner utanför skoltid i andra ämnen
l)   Plugga eller göra läxor i andra ämnen på egen hand

Q 27. Hur viktigt tycker du rent allmänt att det är för dig att lyckas bra i följande ämnen?
(Sätt bara kryss i en ruta på varje rad)
Svarsalternativ: Mycket viktigt, viktigt, inte så viktigt, inte alls viktigt
a)   NO-ämnen
b)   Matematik
c)   Svenska

Q 28. Ungefär hur lång tid varje dag läser du för nöjes skull?
(Sätt bara kryss i en ruta.)
        Jag läser inte för nöjes skull
        30 minuter eller mindre varje dag
        Mer än 30 minuter men mindre än 60 minuter varje dag
        1 till 2 timmar varje dag
        Mer än 2 timmar varje dag

Q 29. Hur ofta läser du följande för att du vill det?
(Sätt bara kryss i en ruta på varje rad.)
Svarsalternativ: Flera gånger i veckan, flera gånger i månaden, ungefär en gång per månad, några gånger per år, aldrig eller nästan aldrig
a)   Tidskrifter/veckotidningar
b)   Serietidningar
c)   Skönlitteratur (romaner, noveller, berättelser)
d)   Facklitteratur
e)   E-post och Webb-sidor
f)   Dagstidningar

Q 30. I vilken grad håller du med om nedanstående påståenden?
(Sätt bara kryss i en ruta på varje rad)
Svarsalternativ: Håller absolut med, håller med, håller inte med, håller absolut inte med
a)   Jag läser bara om jag måste
b)   Läsning är en av mina favorithobbies
c)   Jag tycker om att prata om böcker med andra människor

d)   Jag tycker det är svårt att läsa klart böcker
e)   Jag känner mig lycklig om jag får en bok i present
f)   För mig är läsning slöseri med tid
g)   Jag tycker om att gå till en bokhandel eller ett bibliotek
h)   Jag läser bara för att få den information jag behöver
i)   Jag har mycket svårt för att sitta stilla och läsa i mer än några minuter

Q 31. Vad heter du?
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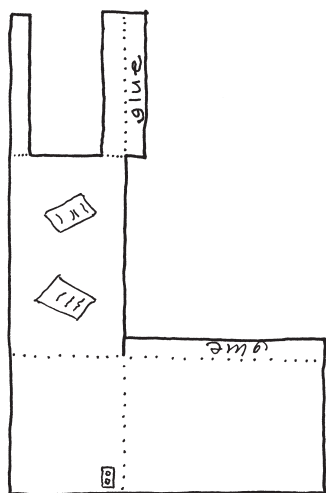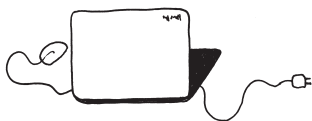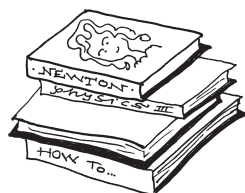Joshua

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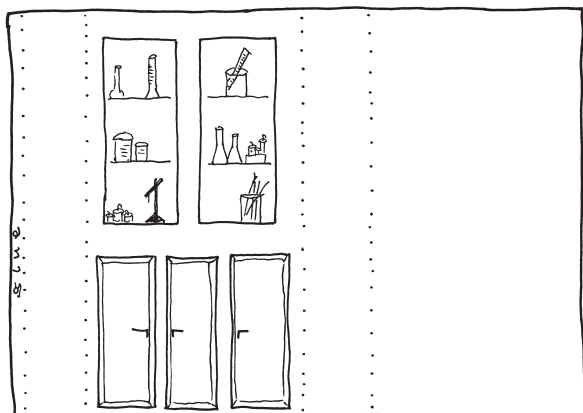Nicholas

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physics classroom

cut along the solid
lines
fold along the dotted
lines

you need:
scissors and paper glue

glue

glue

pupils desk

cupboard