



GÖTEBORGS UNIVERSITET

What effects the teacher and the curriculum have on students' learning
- A comparative essay of Science Education
at Sixth Form in England and in Sweden.

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Abstract

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The aim with this examination paper is to compare science education at Sixth Form in England and in Sweden in regard to the curriculum and how it affects students' learning. I also investigated teachers' experience of the curriculum and how it affects planning and structuring of science education. As well as investigating how students perceive their science education and how the educational structure in the classroom affects students' learning. I used a qualitative text analysis, observations and interviews as my methods. The qualitative text analysis was used when investigating the differences in the curriculum regarding the extent of and details in the subject content. The observations were a non-participating observation. Five teachers were interviewed, two in Sweden and three in England as well as eight students in each country in groups of four, in focus group interviews.

The main results from this investigation is that the curriculum in England is very extensive and detailed concerning the subject content which leaves no room for teachers to address anything else besides the subject content in the curriculum. The teachers experience lack of time for all details of the subject content presented in the English curriculum. The teachers in Sweden experience much more freedom concerning the planning and teaching science due to the more general subject content in the Swedish curriculum. This curriculum presents the science topics but lacks detailed information of the subject content to address and its extent. English students feel pressurised in accomplishing good grades which are mainly based on their exam results, while students in Sweden feel that they have sufficient with opportunities to demonstrate their scientific knowledge to the teacher. The educational structure in the classroom in England is mainly based on students' individual work. The Swedish students mainly work together which could have a positive effect on their learning process.

Introductory remark

I would like to convey my appreciation to everyone that made this study possible. Above all, I would like to thank Adlerbertska Scholarship Fund for aiding me in my quest to travel to England to investigate science education at Sixth Form College. Also I would like to thank both the Sixth Form College in Brighton and in Gothenburg for having me there while interviewing and observing science education. In addition, I would like to thank my mentor for helping me with the structure in my examination paper and for the language tutor, who helped me improve my written English. Finally, I would like to thank Sofia Sinnerstedt for both her support and guidance throughout this process as well as our enjoyable lunches.

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1. Introduction

In 2009, I studied at the Manchester Metropolitan University in England for six weeks as part of my teacher trainee programme. While over there we visited several Sixth Form Colleges where we received the opportunity to talk to teachers and to students. I was astonished by the differences between Sixth Form in England and Sixth Form in Sweden as regards to the teaching aspects of science and of the curriculum specificity. I was intrigued by the school system in respects to the number of subjects studied by students as well as the governing of the subject content in the curriculum. This is why I choose to further investigate these differences in this examination paper, partly due to my curiosity and partly to my interest in how these structures of science education affects the students' learning process.

The aim of science education is for the teacher to be able to provide the students with opportunities to demonstrate scientific knowledge and methods and to achieve the course goals. The teacher has different factors that need to be taken into consideration when planning and executing science education. The curriculum rule and govern both the subject content and the extent of different aspects within science education. Depending on the specificity of the instructions in the curriculum concerning science, this will have an immediate effect on how science education will take form. The main focus here is how these documents affect the teacher concerning planning and executing the science education and how this affects student's learning process.

1.1 Aim and Problem Formulation

The aim of this examination paper is to analyse how the structure of science education affects the students' learning and to investigate how restricted the teachers feel by the curriculum. I would argue that by comparing the school systems in two different countries leads to a clearer view of each one of them. Therefore I want to do a comparison between Sixth Form College in England and in Sweden, specifically looking into science education.

Sjoberg & Schreiner (2004:20) argues that:

the only way to successful science teaching goes through knowing something about the views and perceptions of the learners. Only by taking departure in *their* view can science education recruit more scientists, foster qualified citizenship or promote sustainable development. Only by meeting the learners at *their* premises can science teaching contribute in developing young people into concerned, empowered and autonomous individuals

This is why I consider it to be important to investigate what affects that the governing of the subject content in the curriculum have on students' learning as regards to the science teaching and its structure at Sixth Form College. In order for students to achieve successful learning it is essential that the teacher constructs the science teaching from students' views and perceptions. Therefore I consider it to be important to investigate how the teacher is governed as regards to planning and constructing science education and as to what affects their teaching have on students' learning process.

I will look into teachers' experience of the curriculum and what kind of changes made to it they would like to see. I will also look into how the students experience their science education, for example whether they feel that they have enough time and space to ask the teacher questions during class or if the teacher experience any time issues concerning science education. In addition I will investigate the curriculum in detail to

look at their specificity concerning the subject content and to the extent of different factors in science education.

The questions that I have chosen as a starting point are:

1. What differences are there in the Swedish and English curriculum and how do these affect the subject content and the planning of science education?
2. How much freedom do the teachers feel that they have as regards to planning and constructing the science education in terms of the subject content in the curriculum?
3. What effects does the governing of the subject content in science education have on students' learning process, according to the teachers?
4. What changes in the curriculum are needed to improve students' learning, according to the teachers?
5. What are the students' view on the structure of science education and how it affects their learning?

2. Background

Sixth Form College is the equivalent to the Swedish "gymnasiet", thus it is the non-obligatory school form in students' school attendance. The English word curriculum is synonymous to the English word syllabus. Therefore my use of the word curriculum is not equivalent to the Swedish word "läroplan" but is closer to the description of "kursplan". I will use the word *curriculum* for the Swedish equivalent of "kursplan".

The first year that students in England attend at a Sixth Form College is referred to as AS which stands for *Advanced Subsidiary* whereas their second and final year at Sixth Form is referred to as A2 which stands for *Advanced*. Therefore the curriculum AS Biology is the equivalent studies that students in England participate during their first year at Sixth Form and A2 Biology would be during their second and final year. Whereas in Sweden, in terms of science, students in Sweden would study the curriculum for science 1b during their first year of Sixth Form and the curriculum for science 2 during their second year.

The aim for students in England is to complete A levels in all subjects, achieving an A level means that the students has completed both AS and A2 studies and combined they form what is referred to as an A level. The grades that the students in England receive in their A levels is what they use when applying to universities. Students in Sweden receive a grade in every subject which is later on combined into a merit value that they use when applying to universities.

Table 1 presents an overview of the educational structure for Sixth Form College in England and in Sweden.

Table 1. Comparison between the English and the Sweden school system.

	English Sixth Form	Swedish Sixth Form
<i>Length of study</i>	2 years	3 years (a few 4 years)
<i>Age when Sixth Form Education start</i>	16-17	15-16
<i>Number of Subjects</i>	4 subjects for 2 years	10-12 subjects / year
<i>Science courses to choose</i>	Physics, Chemistry and Biology	Science 1b, Science 2 and Chemistry, Biology and Physics as separate courses
<i>Amount of teaching hours if an English student studies chemistry as one of his/her subjects / if a Swedish student studies Science 1b and Science 2</i>	432 hours in 2 years	200 hours in 2 years

<i>Assessment</i>	20 % is based on the teacher's assessment of the student's practical skills, the remaining is assessed by one of the Examination boards that constructs and corrects two exams every year for every subject.	100 % of the student's grade is based on the teacher's assessment, which in turn is based on the grading criteria in the curriculum.
<i>Curriculum</i>	Constructed by the Examination board that assesses the student's examination tests. There are several Examination boards which all have different curricula for different subjects. The school's departments decide which curriculum from which Examination boards that the department should follow.	Constructed by the organisation Skolverket, which is responsible for all of the governing documents concerning school. All schools have the same curriculum in every subject.

3. Theoretical Background

3.1 Frame factor theory

According to Sundberg (2007:10) referring to Lundgren (1972) the frame factor theory consists of three factors that govern the educational processes: (my translation) "(i) factors given in the curriculum – goals and content, (ii) time available for instruction, (iii) the composition of the class according to the time different pupils need to reach a certain goal". Sundberg (2007:11ff) claims frame factor theory is essentially about constraining and directing conditions in the teaching process. It has to do with how they are being presented through verbal speech, in writing, visual aids, body language, styles of clothing etc. It was made clear that in every pedagogical practice there are governing principles that structure the choice of work methods, content etc. within the teaching process.

According to Sundberg (2007) the conception *framing* refers to the degree of control that the teacher and the students have over the choice and organisation and the pace that knowledge is conveyed and received. *Classification* refers to the boundaries that are created and recreated between the lesson and break, different subjects, teachers and students etc. Through regulation of stronger versus weaker classification and framing the relations of power and controlling principles are created. A strong framing is recognised by an explicit regulation of the interaction relationship between teacher - student - content - work methods that make up the communicative context. On the contrary a weak framing leaves more space for the student to control the choice of such as: content, organisation and criteria for communication.

3.2 Curriculum theory

According to Sundberg (2007:2) curriculum theory is a critical research about the governing and organisation of education. He explains that: (my translation)

curriculum theory in its wide sense can be viewed as theories that in different ways cover three basic questions: how are the goals for education formulated, how is the knowledge for learning selected and how are the methods for teaching developed

Sundberg goes on to claim that the Swedish, as part of the Nordic didactics and curriculum theory can be understood as a systematic reflection over the goals and effects of education, organisation of education and teaching environments, different teaching situations as well as the choice of educational content.

Sundberg (2007:4) claims that the curriculum, which includes national guidelines, curricula, timetables etc. are not the only formal governing documents that aim to guide the school's work but at the same time defines a set of ideas that together organises knowledge for the school to communicate and transform. The aim with curriculum theory is to problematize the content and its organisation in the education and the teaching from a cultural and society theoretical perspective.

According to Sundberg (2007:14) referring to Young (1977) there are two ways in understanding a curriculum: the first is seeing *curriculum as fact* where the curriculum is considered as a set of goals, knowledge and skills that are conveyed. The second is *curriculum as practice* which is directed on (my translation) "understanding the historical emergence and persistence of particular perceptions, of knowledge and particular conventions for example school subjects".

The curriculum theory went through a discourse change, according to Sundberg

(2007:23ff) referring to Fraser & Bartky (1992) with the focus heading towards the language and that the human being is a language and societal being. Sundberg (2007) referring to Säljö (2000) claims that this discourse change is a shift in focus, from a monologue point of view to a more dialogue point of view and from simply being aware of a fact to interacting with others in order to achieve learning.

3.3 Sociocultural approach

According to Lundqvist (2009:17) in a sociocultural approach it is viewed that by interacting with others our understanding and knowledge grow. On our own we can only develop to a certain extent but through interactions with others we can develop exceedingly. According to Lidar (2010:14) and Lundqvist (2009) learning from a sociocultural approach means that students can only learn once they are together with other persons that use these science concepts or ideas, in order to discuss, explain or solve problems. Until the students do this they cannot be incorporated in the scientific culture.

According to Andersson (2001:12ff) science main objectives of knowledge is made of socially constructed conceptions and theories for example atom, gene, evolution and molecules. In order to discover these kinds of conceptions the students need to socialise with other people that use these conceptions when they are telling, explaining, discussing and problem solving. It is all about becoming a part of a social culture, something that is referred to as *cultivation*. Both social and individual construction of knowledge is needed in order to achieve scientific learning.

Andersson (2001) and Lidar (2010:20) goes on to argue that it is crucial for the teacher to both incorporate students everyday science knowledge as well as the scientific knowledge in his/her teaching. They are each other's opposites and are both needed in order for the students to overcome the gap between their everyday knowledge about science and the scientific knowledge that the teacher aim for the students to learn. It is essential that there is a clear connection between these two kinds of knowledge in order for the students to not only know the formula but also that they are able to explain how this affects their everyday life. It is important to allow the students to reflect over their own everyday knowledge because it is a part of their development. They need to be able to see the differences between their everyday knowledge and the scientific knowledge in order to develop their knowledge towards a more scientific one.

Säljö and Wyndhamn (2002) claims that what is important in this respect is for the teacher to use *contextualisation* in order for the student to orientate within the relevant dimensions. The teacher needs to guide the student towards the more relevant dimensions by using contextualisation. This is used to help the student in moving the conversation towards a more scientific dimension and to move away from the knowledge that is based on their own life experience. By making the students attentive of their relation between their experienced understandings and the scientific understanding, learning becomes possible.

According to Östman (2002:79) the insights of *constructivism* about how learning is achieved is when the teacher realises that the students have everyday knowledge and that these are stable and robust, close to being teaching resistant. In order for the teacher to have an effective conception teaching the teacher has to take these everyday knowledge into consideration when constructing science education.

Östman (2002:84) claims that students should be given the opportunities to communicate science amongst themselves. They should also be encouraged to discuss their own questions and thoughts to the teacher. Students need to be given more time and practice in being able to use the scientific language.

Helldén (2002:228) referring to Ausubel (1978) argues that: (my translation)

"the single most important factor that affects learning is what the learner already knows. Find that out and teach accordingly". Helldén (2002) claims that meaningful learning occurs when the student chooses to relate new conceptions to the already familiar ones. The prerequisite for this is that the taught subject content is considered as being meaningful for the student. Also that the student comprehends the conceptions that are relatable to the new information as well as choosing to learn meaningfully, this is referred to as *progressive differentiation*. It is important to be able to help the students in developing their own ability to speak and write about scientific phenomenon in a context that comes natural to them.

3.4 Practical epistemology

According to Lundqvist (2009:20) referring to Wickman & Östman (2001, 2002a, 2002b) an analysis of humans' practical epistemology is a description of what people do and say in order to create a direction for the new meaning within a practice. The epistemology that can be studied is our actions when we create meaning by speaking and acting in ordinary situations.

Practical epistemology is, according to Lundqvist (2009) and Lidar (2010:27) referring to Lave (1993) a part of the students' learning process, a mean to create knowledge about the role that sociocultural resources has as a direction giver. What is being taught is problematic because it is important to create an understanding for the direction that learning takes.

One way of understanding learning from a short time perspective is by looking at learning as a changing process and as a way of getting from one practice to another. If a student is able to overcome this gap between practices and create new relations to what is already known, the student has learned something new. The student's experience is therefore changed and a new practical epistemology is created in relation to what the new situation contributed with. Learning from a longer time perspective evidently means a change of habits or a creation of new ones.

According to Lundqvist (2009:12) the term *manner of teaching* is used to describe the direction of the teaching in the classroom. A way to describe the teacher's way of communicating the subject content to students. Lidar (2010) and Lundqvist (2009:46ff) states that one way of teaching can be characterised as being *epistemological direction provider*, thus the teacher uses different means in order to direct the students towards the goals that are valid within a specific practice. Hence the teacher shows the students what is considered as correct knowledge and of reasonable ways of achieving this knowledge within a specific practice.

Examples of ways that the teacher demonstrates this is by using: *confirmation*, *reconstruction*, *instruating*, *generating* and *reorientation*. *Confirmation*: a teacher assures that the student is on the right track. *Reconstructing*: a teacher acknowledge facts that are important but have been ignored. *Instruating*: the teacher instruate students how to notice important content. *Generating*: a teacher allows the student to summarise what is essential in order to draw conclusions. *Reorientation*: the teacher demonstrates to the student that they need to reconsider their reasoning. To sum up these different epistemological direction providing are essentially about the privileging the teacher uses to direct students into taking a reasonable way within science education to retrieve the 'correct' knowledge.

3.4.1 Privileging

According to Lidar (2010:34) and Lundqvist (2009:28ff) privileging, also known as *selective attention* is taken place where students come across a certain amount of

information where they consider some aspects to be more relevant than others. This will lead to that students will use some of the information given and reject other parts of the information. This privileging creates a direction for students' learning and an important part of teaching is knowing how to privilege in a certain context.

By using privileging the teacher can demonstrate to the students reasonable ways in order to retrieve the appropriate knowledge. The privileging that the teacher performs in the classroom is to place attention towards the relevant subject content for the aim of the lesson.

3.5 Content learning

Dimenäs (1996:21ff) presents *substance crowding* where the focus in science education lies in squeezing in as much content and facts as possible. Dimenäs (1996) referring to Andersson (1989) claims that substance crowding is catastrophically for the average student's knowledge development. The only possible way of learning is by memorising something without having an understanding for it. In the long run, this leads to that students loses his/her motivation and their interest for the subject.

Instead the substance amount needs to be reduced in exchange for lasting understanding of the taught conceptions. Dimenäs (1996) referring to Säljö (1995) argues that a Swedish student faces too many scientific conceptions under a very short period of time. Students are being taught "already chewed"(my translation) knowledge and Säljö (1995) in Dimenäs (1996) suggests that the school should develop working structures and communicative patterns that provides contact with science instead of holding on to already formulated and packaged key conceptions. When students are given the opportunity to discuss and argue about a content they will eventually learn the content and at the same time develop their communicative ability. According to Dimenäs (1996:62) as regards to choosing what subject content that should be taught in class it is important that the teacher chooses a small number of important processes that students need to become familiar with and to achieve an understanding for it.

3.6 Previous Research

According to Hofvendahl (2010:37ff) referring to Hofvendahl (2006c) *the red pen mentality* is when a teacher comments on a student's performance by highlighting their faults and mistakes instead of focusing in the positive aspects of a student's achievement. In eight out of ten cases the teacher has a red pen mentality with a focus on the student's faults and mistakes instead on focusing on the positive aspects. Thus the teacher decides to focus on the negative or the potentially negative even though it only makes a small part of what the student has achieved.

Hofvendahl (2010) claims that this leaves the student feeling a sense of failure, even if they have scored 99 out of a 100 on a test, they feel as if they have not achieved what they were meant to achieve. The teacher's mistake is commenting on the faults that have no real significance to the student's learning process and their knowledge development as well as their sense of achievement. This is a clear violation to the current National Curriculum (läroplan) for Swedish Sixth Form students where it reads; (my translation) "the school shall stimulate the student's creativity, curiosity and self-confidence" as well as the fact that "the school shall strengthen the student's belief in themselves and in the future"(Skolverket 2011:4).

According to Klapp Lekholm (2010:131) there is a Swedish tradition of classroom assessments and a credence to the teacher's ability to assess students' knowledge and on their own decide what grade the student have achieved. The different types of classroom assessments together make up a large amount and variety of

assessments that occurs daily in the classroom. Where the assessments of the student takes place over a long period of time before the teacher decides the student's grade. This means that the grade is based on a large number of assessments and different kinds of assessments, compared to if the student would have been assessed on one single occasion, for instance in an exam situation. At occasions where an exam is taken place, Klapp Lekholm (2010) claims that other aspects than the student's knowledge can affect the outcome, for example if the student is nervous, lack of sleep due to stress or if due to the circumstances that the student have trouble in demonstrating their knowledge.

According to Korp (2010:145f) the idea behind *participating goal-steering* was that the curricula subject content would be less detailed and instead would be concretise in such ways that they fitted into different programmes and local contexts. This means that students from different Sixth Form Colleges with the help of different knowledge content would be provided with equally good or equivalent possibilities for developing learning skills to achieve in the curricula.

According to Illeris (2007:289ff) *self-directed learning* is a central conception within the English speaking countries. What it means is that the students themselves are responsible for planning and constructing their own learning. Which means that even though students have lessons in science, their learning is their own responsibility. This is referred being a more individualistic oriented learning approach. Whereas in the Nordic countries *peer-directed learning* is more commonly used. Which means that all participants including teachers, students and other people involved governs the activities together and together they make the governing of the activity to an essential concern. This is very valuable for both the quality of learning and for the motivation to learn.

Sjøberg & Schreiner (2004) referring to Cerini et. al (2003), a recent English study *the Student Review of the Science Curriculum*, which was a web-based survey that collected data from about 1500 14-19 years old students at English schools. One conclusion of the study was that:

the students would have preferred a Science curriculum including more contemporary socio-scientific controversial issues as well as more philosophical and ethical matters. In general, the students showed high interest in topics suitable for discussion and deliberations, while fact-oriented topics had less appeal. When the students were asked explicitly about teaching methods they found most enjoyable, "Having a discussion/debate in class" received high scores (pp.52)

Thus what students in England want more of in their science education is to be able to discuss and deliberate science with their classmates and for the teachers to move away from the fact-oriented topics and more towards the contemporary socio-scientific controversial issues. Other studies that confirms these findings are a focus group study by Osborne & Collins (2000:2001) and another study by Jarman & McClune (2002).

Methodology

During my investigation I used the following methods: text analysis, interview and observations. I used the text analysis on the science curriculum in England and in Sweden at Sixth Form College. The science curriculum for chemistry, physics and biology in England and the science curriculum 1b and 2 in Sweden. I interviewed three teachers in England, one biology teacher, one chemistry teacher and one physics teacher. Also I interviewed two science teachers in Sweden as well as a total of eight students in England and eight students in Sweden in groups of four, thus a focus group interview. During my observations I used my theoretical background as my starting point when looking at how the subject content in the curriculum governs the science education in England and in Sweden.

4.1 Text analysis

According to Esaiasson et al. (2010:239ff) a *discourse analysis*, a qualitative text analysis, is about illustrating the power relations that exists in society. Besides shedding light on power relations and that discourse analysis's approach includes language and forms reality. Texts and other human expressions are of crucial significance concerning how we perceive the world. One aspect of discourse analysis is the role that language play in the social construction of the world. Also a discourse analysis aim is to perform critical research that explore the power relations in society as well as formulating normative perspectives from where the power relations can be criticised.

Performing a text analysis using an open approach means that the research is more governed by the content of the texts that are being analysed. With an open approach a more general limitation is made about, for example what is meant as detailed subject content within the curriculum for science education.

One of the dangers in applying an open approach to the text analysis is that it can easily move away from the key questions and more towards entertainment value. Sometimes the researcher starts paying attention towards the results that are more interesting to the researcher than what is actually relevant in answering the key questions. Therefore it is important to keep focusing on the key questions and to make sure that the questions is always there in the background. Another danger with using an open approach is that the results is very dependent of what is found in the materials. The solution to this danger is to go through what other answers that could possibly be found in the research.

According to Esaiasson et al. (2010: 247ff) in a discourse analysis the discourse needs to be limited, it is safer to limit the analysed material selection than to analyse a large amount of materials. The key questions interest is to answer the explicit message of the analysed materials as well as looking into the implicit message. The analysis of the curricula are analysed after their explicit message concerning the description of the subject content. According to Esaiasson et al. (2010: 252) what is referred to as the golden rule is when analysing texts you should interpret generously. What is meant with generously is that you should assume that the text holds a position that is worth taking seriously. In addition you should challenge your own conceptions in order to achieve the most possible insight.

When looking at the English curriculum for chemistry, physics and biology or the Swedish curriculum for Science 1b and 2 I will use the discourse analysis which is explained in Esaiasson (2010). My main focus is to look at the freedom versus lack of freedom that the teacher have concerning planning their own teaching. Thus I will look at how detailed the subject content is explained in the different syllabuses. My analysed material selection is limited to the English curriculum for chemistry, physics and

biology as well as the Swedish curriculum for Science 1b and 2 at Sixth Form.

By using the discourse analysis the subject content in the curriculum would be viewed with an open approach in order to achieve a perception of how detailed the subject content are in the curricula. The results of the discourse analysis will later be presented in the results section as well as discussed in the discussion section as to what consequences the results have concerning students' learning.

4.2 Interviews

According to Esaiasson et al. (2010: 283ff) a researcher should strive for an understanding of the world the way that the interviewed person perceives their world. The main focus in an interview is the way that people perceive different concepts and not to focus on source criticism. These perceptions cannot be claimed to be counted for truths or untruths. The challenge, concerning interviewing, is to come as close to the interviewed person as possible. The challenge of getting close enough in order to see the interviewed person's way of thinking and their perspectives. One thing to watch out for is one's own prejudice about how people should answer or flawed answers that lacks in providing the research with good material to work with.

According to Esaiasson et al. (2010:291ff) referring to Grant McCracken (1988), as regards to choosing people to be interview provides three advice; choose strangers, a small number of people and those that are not subjective experts. The limit for the quantity of interviews depends on when the interviewer considers that further interviews will not add anything new in terms of essential information for the research. The quantity of interviews also depends on the amount on time that can be spent on each interview both before and after. The most important aspect concerning interviewing is that the selection and limitations that are made are well thought through and also that they are well prepared.

The way I conducted my interviews was that I made sure that we had a private classroom to sit in to make sure that we were not interrupted when interviewing the teachers. With the students I made sure that we sat in a surrounding where they felt comfortable which was in the classroom, where I interviewed them in groups of four. The interviews with the teachers were about 30 minutes long and the interviews with the students were about 15 minutes long due to the amount of questions that differed from interviewing the teachers and the students.

The teachers in England that I wanted to include in my investigation was due to the three aspects in science. Therefore I decided to interview the physics teacher, chemistry teacher and the biology teacher. Whereas in Sweden I interviewed two science teachers because I thought it would be sufficient with interviewing two Science teachers. This is due to that I felt that a third science teacher would not add anything new to my research as well as the fact that there simply were not enough time to do so. The students that participated in my research all volunteered to be part of my research, I asked the entire class the following question after I told them the aim of my research: *would you like to be a part of my research by answering some questions to provide the research with the students' point of view?*. The students were informed of the fact that they would be completely anonymous in my research and also that they could stop the interview at any given time.

For my interviews, I recorded the interviews with the teachers, both in England and in Sweden. After the interviews I listened to them and took notes on some of the key points that they made concerning my questions as well as transcribing the exact words in order to use quotes in the examination paper. Although, not everything from the interviews in transcribed onto paper due to the lack of time available for that sort of processing. For my interviews with the students I kept notes, mostly key words or

sentences during the interview as well as afterwards writing their remaining opinions that I did not have time to write during the interviews.

4.3 Observations

Lundqvist (2009) claims that the only reasonable way of observing whether a student fully comprehend a concept's meaning is by observing how the concept is used within a context. A word or concept can only fully be understood in its context henceforth it is impossible to once and for all define a concept so that it can be used in all contexts. According to Lundqvist (2009) referring to Wittgenstein (1953/1992) this makes it pointless to talk about concepts without putting them into a context, without a context the concept is worthless.

According to Esaiasson et al. (2010:344), direct observations is appropriate when researching processes or structures that can be difficult for the persons involved to describe themselves and is therefore suitable to use observations to make them visible. Guidelines when observations is suitable are: (my translation)

- When one wants to study something that seems obvious for people that it does not occur to them to talk about it during their interview.
- When one suspects that the discrepancy is large between what people say they do and what they actually do.
- When the research is about something that is sensitive or controversial that people do not often talk about it for example in an interview situation.

Furthermore it is important to address as to what areas of research that observations cannot be used; when investigating what people's intent behind their actions are or their interpretations of different situations.

My observations could according to Esaiasson et al. (2010:346) be characterised as being passive participation, only a short period of contact with what was being observed. The manipulation was close to being non-existent, my intentions where in the middle of being hidden and total recognition. My construction of the environment was natural and finally my collection of data was quite open.

Esaiasson et al. (2010:354) referring to Miles & Huberman (1994) advice that when compiling the observations one needs to summarise the key words or key formulations that include what was considered of being the most striking in the situation on one page. Included on this page should be where the essential information is gathered and in what ways the observations leads the research forward. When analysing one's observation data means that one transcribes, does repeated readings of the data, detailed categorisations and in a systematic way try to work out more complex patterns.

The way my observations worked was that I introduced myself to the students as to what I was doing in their classroom, the aim of my examination paper and what I was going to observe in a short explanation. After that I sat in the back of the classroom where I could have a clear view overlooking the classroom and where I could clearly see and hear the teacher as well as the students. My aim was to get by as unnoticed as possible while sitting in the classroom in order for the teacher and the students to act as natural as possible.

During my observations, my starting point was to use the conceptions in the theoretical background, I took notes on how the teacher guided the students towards the correct knowledge and the methods used by the teacher. I also took note of what theoretical approach that the teacher was representing, thus implicitly looking at the teacher's view on learning. Furthermore I took notes on the role that the students played in the classroom, if there were any room for their everyday knowledge, their reflections

and thoughts about science in general. As well as looking at the role that the syllabus played in science education, thus how much influence the syllabus has on the education versus how much the teacher can interpret and contribute to his/her own education.

4.4 Selection

My interviews and observations in England were at a Sixth Form College in Brighton and at a Sixth Form College in Gothenburg in Sweden. The reason behind my choice of Sixth Form Colleges is due to the fact that my contact at Brighton University had a contact at the Sixth Form College in Brighton. The Sixth Form College in Gothenburg is the one that I have had my practice in and could therefore easily contact teachers because they had previously met me and knew who I am.

My selection of curricula to analyse using the discourse analysis is limited to the English curriculum for physics, chemistry and biology as well as the Swedish curriculum for Science 1b and 2.

My selection of lessons to observe was based on the idea that I wanted to observe the people that I interviewed, therefore I performed a total of five observations during the process of my examination paper. All observations were 60 minutes long, where I sat in the background in order for the teacher and the students to ignore as much as possible the fact that I were observing them.

My selection of people to interview were limited to a total of five teachers, two teachers in Sweden whom teach Science, three teachers in England with one of them teaching in physics, one in chemistry and one in biology. This was in order to get all of the aspects of science represented in both countries. I interviewed the teachers separately in order for them to feel comfortably in speaking their mind without having to explain their reasoning to their fellow co-workers as well as having enough time to get a sense of their views and opinions as regards to my interview questions.

For the students, by doing a focus group interview, I perceived that a group of four people would be the appropriate number of people in order for the students to feel that they have an opportunity to address their opinions and that the group is small enough for them to feel comfortable in speaking their minds. I interviewed two different groups of four students in England as well as in Sweden. The groups were not interviewed at the same time, but at different occasions.

The reason behind my amount of interviews is simply because the amount of time given for this examination paper. If I would have been given more time to write this examination paper I would have conducted more interviews and observations. Due to the time issue, this is what I had time for considering the before and after work around the interviews and observations.

4.5 Ethics

According to Vetenskapsrådet (2002), the researcher shall inform the people that are involved in the research, which includes both observations and interviews, that all of the materials that are gathered during the investigation will be used to nothing but the investigation itself. The people involved also have the right to be informed of what the research is about, concerning the aim of the research, before participating in the research as well as the fact that they are completely anonymous and that at any given time they can withdraw their participation.

The people that are asked to participate in the research have the right to decline. If there are any respondents that are younger than 15 years old their legal guardians must be asked for permission before the respondent can participate in the investigation. Due to the fact that no one under the age of 15 participated in this research, no

permission was asked from the respondents' legal guardians.

I clearly informed the people involved about my research and the aim of my research before both my observations and my interviews. Before my interviews I asked the people concerned if they wanted to participate anonymously as part of my research. I also told them that they could end their participation from my research at any given time and that everything concluded from my research is only used for research purpose. Before my interviews I asked the teachers if they would mind me recording the interviews on my laptop which would enable me to give a clearer picture of the teacher's views, all teachers approved of the recording. In addition I also asked the students the same thing, but some of them felt uncomfortable with the fact with their opinions being caught on tape, therefore none of the interviews with the students were recorded.

4.6 Validity, Generalizability and Reliability

4.6.1 Validity

According to Stukát (2005:125ff) a valid investigation is if one measures what is intended to measure. The main focus during my observations was to look at the concepts explained in my theoretical background. Although there were moments where I could have been looking at other concepts as well, consequently those are not included in my results besides the concepts of my theoretical background. Concerning my interviews I would argue that the people that were interviewed were being as honest as they could, given the circumstances on which I interviewed them. Stukát (2005) argues that one must create a trustworthy situation in order to avoid dishonest answers during interviews. The situations where I interviewed were in their natural surroundings for both students and teachers since I did my interviews at the school that they go to /work for. According to Bell (2000:90) the aim of the investigation is to achieve a representative selection of answers in order to fulfil the aim of the examination paper as well as answering one's key questions. I would argue that for this examination paper I achieved a representative selection of answers considering the time provided for this investigation. If I had been given more time to investigate my key questions the selection of answers would be more representative than what they are now.

4.6.2 Generalizability

The intention of this examination paper is to exemplify the effects of the governing of the subject content in the science curricula have on both teachers and students. This examination paper is in no way a mean to draw larger conclusions for the public and to draw general conclusions about science education in both England and in Sweden. This is simply an examination paper with a purpose to shed light on how the governing of the subject content in the science curricula can affect both science teaching as well as the students' learning process within science education. According to Stukát (2005: 125ff) relate ability is when one describes their case in relation to similar situations in order for others to create comparisons on their own situations. I would argue that my examination paper is relatable in that sense that it describes my investigation in relation to similar situations in order for others to create comparisons on their own situations. My examination paper is not a foundation to draw general conclusions from due to the fact that my selection of people to observe and interview are not representative for students and teachers in England and in Sweden. Also the number of people that I observed and interviewed are too few in order to draw general conclusions from the results in my investigation.

4.6.3 Reliability

According to Stukát (2005:125ff) one must argue over their investigation's strengths and weaknesses in their examination paper. The strengths of this investigation is that it clearly describes the differences between teaching science in England and teaching science in Sweden from the teachers' point of view. In addition it describes the difficulties of teaching the subject content concerning students' learning as well as how the different curricula affect the teaching in the classroom. The weaknesses of this investigation is that the results are not enough to draw generalisations about science education at Sixth Form or what consequently affect students' learning positively versus negatively. In addition the investigation cannot generalise about how teachers experience that their teaching affects their students' learning. According to Bell (2000:89) deficits that can occur in investigation are: wrongly interpreted questions by the interviewed or wrongly interpreted answers by the interviewer. In addition disturbances during the investigation can also have an effect on the results, for example one of the interviews took place in one of the teacher's office which is built in a classroom therefore noise from the classroom could have been a disturbing factor.

According to Esaiasson et al. (2010:355) referring to Kaijser & Öhlander ed. (1999:80); (my translation) "a fundamental principle for direct observations is when something can potentially be observed and comprehended in similar ways by several individuals that is considered of being valid data". The issue with validity is less concerning simple and uncomplicated theoretical conceptions that are close to what is later on measured on the operationalized level. By using my theoretical background as a starting point my observations could potentially be observed and comprehended in similar ways by several individuals. Therefore I would argue that my observations have a high reliability whereas my interviews have a low reliability. According to Bell (2000:89) when interviewing someone there are a lot of factors that can influence their answers. This is due to that the interviewer is after someone's opinions and that people's opinions change frequently. For example if the interviewed person has recently viewed a television show or was recently involved in an event that could potentially have influenced that person's opinions. Therefore my interviews have a low reliability due to the fact that if someone were to take my interview questions and do the same interviews that I did, the results would most likely be different than what they are now.

5. Results

From now on I will use fictitious names for the interviewed teachers. The biology teacher in England will be referred to as David, the physics teacher in England will be referred to as Tom and the chemistry teacher in England will be referred to as James. The first science teacher in Sweden will be referred to as Sara and the second science teacher will be referred to as Johan. When addressing the students' opinions I will simply write if the opinions comes from the students from England or from Sweden, I will make no distinction between the students since they were interviewed as a group.

5.1 What differences are there in the Swedish and English curriculum as regards to subject content and how does this affect the planning of science education?

The first significant difference when looking at the different curricula is that the Swedish curriculum for science 1b and science 2 is, concerning the subject content, combined a total of 4 pages. Whereas the English curriculum for biology AS and A2 is a total of 31 pages concerning the subject content that should be addressed in science education. The curriculum for science subjects biology, chemistry and physics in England, AS and A2 is very specific and detailed as regards to the subject content.

It is important to take notice to the fact that my use of the word curriculum is in this context synonymous to the word syllabus, whereas in Sweden curriculum is often referred to as the National Curriculum where the school's fundamental values is included. This is not the case in this examination paper, when referring to curriculum one is only referring to the syllabus and its subject content in science education.

Table. 2 Examples taken from the curricula from England and Sweden.

Syllabus	England	Sweden
A2 Biology / Science 2	<p><u>"Homeostasis is the maintenance of a constant internal environment</u></p> <p>The importance of maintaining a constant core temperature and constant blood PH in relation to enzyme activity. The important of maintaining a constant blood glucose concentration in terms with energy transfer and water potential of blood. The contrasting mechanisms of temperature control in the ectothermic reptile and in endothermic mammal. Mechanisms involved in heat production, conservation and loss. The role of hypothalamus and the autonomic nervous system in maintaining a constant body temperature in a mammal. The factors that influence blood glucose concentration. The role of the liver in glycogenesis and gluconeogenesis. The role of insulin and glucagon in controlling the uptake of glucose by cells and in activating enzymes involved in the interconversion of glucose and glucagon. The effect of adrenaline on glycogen breakdown and synthesis. The second messenger model of adrenaline and glucagon action. Types I and II diabetes and control y insulin and manipulation of the diet". (AQA, 2009-2010, pp.29)</p>	<p>“The human body's organs and organ systems, their structure, their features, evolutionary development and correlation with the surrounding”</p> <p>(my translation). (Skolverket w.y. a)</p>

AS Chemistry / Science 1b	<p><u>Greenhouse Effect</u></p> <p>"Candidates should be able to: (a) explain that infrared radiation is absorbed by C=O, O–H and C–H bonds in H₂O, CO₂ and CH₄, and that these absorptions contribute to global warming; (b) explain that the 'Greenhouse Effect' of a given gas is dependent both on its atmospheric concentration and its ability to absorb infrared radiation; (c) outline the importance of controlling global warming resulting from atmospheric increases in greenhouse gases; (d) outline the role of chemists in minimising climate change resulting from global warming by: (i) (ii) providing scientific evidence to governments to verify that global warming is taking place, investigating solutions to environmental problems, such as carbon capture and storage, CCS, ie the removal of waste carbon dioxide as a liquid injected deep in the oceans, storage in deep geological formations, by reaction with metal oxides to form stable carbonate minerals, (iii) monitoring progress against initiatives such as the Kyoto protocol" (OCR 2011, pp.35-36)</p>	<p>"Questions concerning sustainable development: energy, climate and affecting the ecosystems. Ecosystem services, resource exploitation and the ecosystem's buoyancy" (my translation). (Skolverket w.y. b)</p>
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The way that the curricula in England affect the subject content and the planning of science education is that every bit of science education in England is governed and controlled by the curriculum, thus the syllabus. Due to the fact that the curriculum is very detailed, it leaves no room for teachers in England to interpret any part of the curriculum due to the detailed subject content. Everything that the teacher ought to address is in the curriculum and clearly described in detail.

Whereas the curricula in Sweden are very little controlled as regards to the subject content in science education. Instead the curricula are structured in a way that science topics are described but to no greater extent. This leaves room for interpretation to what extent the subject content should be addressed from the curriculum in science education.

5.2 How much freedom do the teachers feel that they have as regards to planning and constructing science education in terms of the subject content in the curriculum?

5.2.1 English teachers

According to the teachers in England: David, Tom and James, they feel that they have close to no freedom concerning the subject content in science education. This is due to the curriculum being tremendously specific and detailed which leaves the teachers with no time or room in their science education to decide what subject content to address in their teaching besides the detailed content in the curriculum. Although they do feel that they have some freedom as regards to what methods to use when teaching the curriculum. According to David he says that "we don't have a lot of say when it comes to the content, I think there are too much content for the time that is given". Which clearly demonstrates the lack of freedom as regards to planning science education. Time seemed to be the major issue for the teachers in England as regards to having time to be able to go through every little bit of detailed subject content in the curriculum.

According to my observations, the teachers in England have very little say as regards to the content in their teaching. Due to the detailed and extensive curriculum the teachers clearly demonstrate that time is an issue concerning science education. This is made clear when the students and their questions and everyday knowledge are ignored in class due to the lack of time. The main focus for the teachers in England, according to David, Tom and James is to address the correct answer and for the students to take notes

and memorise the answer.

5.2.2 Swedish teachers

According to the teachers in Sweden there is absolutely a level of freedom as regards to planning and constructing science education. Sara says that she feels that the subject content of the curriculum is governed but not very specific and that she has freedom when choosing the methods to use when teaching the subject content. Johan says that he feels that he has a lot of freedom concerning the curriculum. He argues that it is only different science topics that are mentioned in the curriculum. Thus the curriculum does not say anything detailed about the subject content that should be addressed or how it should be addressed or for how long period of time that the topics should be addressed.

According to my observations, the teachers in Sweden have very much say as regards to the content of their teaching. This is due to the short and general description of the science topics concerning the content in the curriculum. Which leaves much of the science teaching to be interpreted and constructed by the science teacher in Sweden. This is clearly demonstrated when the students' questions and everyday knowledge are dealt by the teacher to some extent. In the science classroom, there is room for the teacher to address the students' questions and also to address a topic more freely.

5.2.3 Summary

Thus the teachers in England are highly governed by the subject content in the science curriculum. The teachers feel stressed as regards to the time issue of having time to address all subject content in time for the science exams. Whereas the teachers in Sweden feel that they have freedom as regards to constructing science education and that the subject content in the curriculum is not particularly governed or detailed.

5.3 What effects does the governing of the subject content in science education have on students' learning process, according to the teachers?

5.3.1 English teachers

The teachers in England all said the same thing that due to the detailed subject content in the curriculum, time is always an issue as regards to teaching science. Because there is a large amount of content that needs to be addressed and little time is provided. Therefore the teachers feel pressured concerning having time to address all of the content in the curriculum because it is the content that the students are tested on in the exams. James argued that teaching and preparing the students for the examinations; "it's like training horses, you train them to pass the exam". Time is always an issue, it's quite pressurised, says James. David adds that the teachers are under a lot of pressure as regards to addressing all of the content in the curriculum and preparing the students for the exams.

From the students' point of view, according to the teachers in England, the students considered it to be a positive thing with the content in the curriculum being very detailed. This is because it then becomes very clear to the students what knowledge the students need to achieve. Also the students know from very early on in the semester at what point that they need to demonstrate their knowledge. Although this is a positive thing for the students that the curriculum is very clear there is also a large amount of pressure that is put on the students. A pressure that the students feel that they need to acquire a large amount of knowledge within a time limit. Some students, says James cannot handle the pressure and crack under pressure whereas some students thrive on it.

The time issue for the teachers in England is something that I clearly saw

during my observations at the Sixth Form College in England. The teacher seemed very stressed and it was very rare that the teacher had time to address the student's questions other than a quick response, sort of an automatic response. The way that the teachers in England teach is that they go through something with the students and the focus lies with having the students study key words that can be used when answering an exam question. As well as allowing the students to test their knowledge, that they have acquired during the lesson, the knowledge that they have written during the lesson is later on filed in their binder. This is to make sure that the students have all of the notes that they need in order to prepare for the exams. The positive effects with having a detailed curriculum, according to the teachers in England, is that the students receive a highly standardised education, that regardless to where they receive their education, they will still be taught the same subject content in science education throughout the country.

5.3.2 Swedish teachers

The fact that teachers in Sweden have freedom concerning planning and executing the subject content in the science education is according to Johan very good. He claims that a teacher in Sweden, has a lot of freedom to talk about current events with the students, and to have classroom discussions with the students. As well as the fact that the teacher can talk about something that the teacher feels strongly about and something that the teacher feels passionate about and this is something that helps students' in their learning. Sarah adds that the positive side to not having a detailed curriculum is that there is time and room for classroom discussions and that is something that can help students with their learning. The downside with the teachers in Sweden having a level of freedom as regards to planning and constructing science education is that the science education differs from different classroom, different schools in different parts of the country.

According to the teachers there is an issue with standardised education, the idea that any student in Sweden, no matter in what city or in what school should receive an equivalent education to another student who is studying somewhere else. The idea that every student should receive approximately the same education at a Sixth Form College regardless of where the student studies. According to Johan, the downside with the teacher having freedom to decide as to what depth the science topics should be addressed in Sweden. Because then, it depends on the teacher as to what content the teacher finds interesting within the science education topics and that the teacher has a lot of influence as regards to what content the students is exposed to.

From the students' point of view, according to the teachers in Sweden, the students motivation is positively affected, says Johan, by the fact that the teacher can address different contents of the curriculum differently and in that sense make the science education more interesting for the students. Sara claims that the downside is that there is no standardisation for the students concerning their education. This is because science education differs depending on what teacher you have, what school you go to and where you live in the country. Therefore, continues Johan, when the students graduate from Sixth Form they will graduate will different knowledge in science even though they have achieved the same knowledge goals in science that is included in the curriculum and the grading criteria.

What I could see from my observations in Sweden was that the teacher was not very stressed and there were both time and room for the teacher to address the student's questions and everyday knowledge although this was not always done in whole class but more between teacher to student. There was a clear distinction of what the topics that should be addressed in the science education although different teachers addressed them in different ways and allowed the students to work in different ways which could

affect their learning in different ways.

5.3.3 Summary

To sum up the teachers in England experience a time issue concerning the subject content to address, while the teachers in Sweden feel that they have freedom concerning the subject content to address in science education. Consequently students in England have little room to ask the teacher questions concerning science education whereas the students in Sweden have room for their own questions. Thus, according to the teachers, students' learning process is disadvantaged in England due to the strict schedule of subject content compared to students' learning process in Sweden.

5.4 What changes in the curriculum are needed to improve students' learning, according to the teachers?

5.4.1 English teachers

The teachers in England says that there is too much content in the curriculum and this needs to be reduced. This is in order for the students to walk away with science knowledge instead of knowledge that is only stored in their short-term memory and later on forgotten after the exams. There need to be more time and room for some classroom discussions in order for the students to talk amongst themselves. Because the way it looks now, according to my observations, is that the students are always working on their own, they are never asked to, or allowed for that matter, to work with a fellow classmate. The problem, says the teachers in England, is where do you find a balance between science education where the students receive a equableness education and an education where they walk away with knowledge in science that they can use when going off to university or that they can use in their everyday life.

5.4.2. Swedish teachers

The teachers in Sweden says that in order for the students to receive an standardised education the curriculum need to be more detailed so that the education that the students receive does not depend on what teacher they have or what school they go to. At the same time, Sara adds that if the curriculum would be more detailed she argues that: (my translation) "then it would mean that my teaching would be controlled by somebody else but me, then it would not be my teaching. Because it would be somebody else that governs how every topic should look like and how every topic should be addressed". Johan, on the other hand argues that if the curriculum would be more detailed it would create study motivation for the students. This is because the teacher can therefore say to the students: (my translation) "it is not me that have decided that you should know this, it is the examination board that designs the exams". Therefore a more detailed curriculum would enable to students to know more clearly what knowledge they need to retrieve and learn. At the same time the way it is now, with the teacher having time to address the student's questions and thoughts is something that both Johan and Sara think helps the students' learning. This means that, according to the teachers in Sweden, there are both pros and cons with the way it is now with the science education in Sweden and what it would be like if the curriculum would be more detailed concerning the subject content.

5.4.3 Summary

To sum up, teachers in England argue that the amount of subject content in the curriculum need to be reduced in order for students to be able to retrieve science. They argue that students need more classroom discussions and less subject content to acquire. Compared to the teachers in Sweden who argue that the subject content in the curriculum need to be more specific and more detailed in order for students to receive a equableness education. As well as the fact that it would become clearer for students what knowledge they need to acquire in order to receive a particular grade.

5.5 What are the students' view on the structure of science education and how it affects their learning?

5.5.1 English students

The students in England feel that it is enough to study four subjects at Sixth Form College, compared to the amount of subjects studied during their secondary school attendance. This is due to the amount of homework that they receive in every subjects thus they would not have time for an additional subject. They do not spend much time in school and it is difficult if one is in need for additional support besides the scheduled science lessons. Therefore in order to acquire A levels one needs to be very independent and have a good self-discipline. The student is responsible for a large part of their learning due to the fact that their lessons does not hold any room for their questions. Therefore if there is anything that the students finds unclear, the responsibility lies with the student to investigate for an answer. This means that the students that have a need for extra support, lacking in independent skills and self-discipline will most likely fail to acquire knowledge.

In terms of assessment, the students from England explained that there is a lot of pressure as regards to the exams. That if one have a bad day it will affect one's final grade tremendously. Although there is a lot of pressure behind the exams, the students were comfortable with the idea of the teacher only assessing a fifth of the students' final grade. According to the students, the teachers can be very subjective and your grade can greatly be affected by whether or not the teacher likes you and your personality. Therefore the students' do not trust that the teacher could be objective as regards to assessing the students' performances and set a fair grade.

From my observations I could clearly see that the students in England were always asked to work alone, never encouraged to work or collaborate with a classmate. On the occasions where the students tried to work together, they were quickly reminded that no collaboration was allowed and that they were responsible for their own learning. Thus the teacher was there to provide the students with the correct knowledge and the correct answers. The students were there to receive the correct knowledge that the teacher taught and the teacher were there to guide the students towards the knowledge that was worth knowing as regards to the exams.

5.5.2 Swedish students

The students in Sweden claims that they have time during the lesson to ask the teacher questions and that the teacher have room to answer those questions. In terms of their learning they explain that they feel responsible for their learning but that the teacher has a large part of the responsibility concerning the students' learning. A follow-up question of how the students would describe a good teacher as regards to creating a classroom environment where students feel like they learn something, they answered: The students

defined a good teacher as being a person that teaches one what one ought to learn. In addition to this they claimed it is very important to their learning in the way that the teacher approaches the students when the teacher is asked a question. Overall the students felt that they were met with the support that they needed from the teacher.

By contrast, the students in Sweden explained that the upsides of the teacher being responsible for all parts of the students' grade is that they receive plenty of opportunities to demonstrate their scientific knowledge and practical skills. Whereas the downsides is that if a teacher does not like the student and their personality it can affect the student's grade. Concerning the relation between the student and the teacher.

From my observations I could clearly see that the students in Sweden were often asked to work together during the lessons. The teacher often encouraged the students to work together, to help each other's out with answering the questions asked by the teacher. Some of the students chose to work independently but could ask the teacher if there were any questions that came to mind. Although the majority of the students worked together and helped each other out when working on the lesson's assignments.

5.5.3 Summary

To sum up, students in England argue that the structure of science education is very much based on the idea that students are required to work individually and if a student finds that to be difficult, the student will most likely fail with their education in England. Whereas in Sweden, students argue that the structure of science education works with a mixture of individual work combined with collaboration with their classmates. Also that the responsibility for their learning does not fall on them alone but that the teachers have responsibilities concerning students' learning process as well.

6. Discussion

6.1 Teaching Science

There are several factors that need to be taken into consideration by the science teacher when planning and organising science education. According to Sundberg (2007:11ff) there are three factors that govern the educational processes. Three factors concern the degree of control that the teacher has over the choice, organisation and the pace with which knowledge is conveyed and received. The English schools system, according to my observations, have what Sundberg (2007) would refer to as a *strong framing* where the explicit regulation of the interaction relationship between teacher - student - content that make the communicative context. Consequently this would imply that the students in England have a more controlled environment in their classroom, thus leaving less room for their own questions and thoughts about science. Whereas the Sweden school system would be considered as being of *weak framing* which leaves more space for students to control the choice of content, students' questions and their influence on the organisation of science education, etc. Moreover the students in Sweden would most likely benefit from having a weak framing concerning the development of their scientific knowledge, considering how one's motivation is linked with one's interests.

In order for students to achieve meaningful learning, according to Helldén (2002) they need to relate new conceptions to the already familiar ones. The prerequisite for this is if the student believes the taught content to be meaningful. It is also essential that the student comprehends the conceptions that are relatable to the new information. From my observations in England I did not witness any occasion where the teacher addressed the students' already existing knowledge before introducing new information. In comparison to my observations in Sweden where some of the students' already existing knowledge was addressed by the teacher but it was to such a small extent that I would not believe it to measure up to the extent that Helldén (2002) claims. Thus the students' already existing knowledge is being ignored in both England and Sweden and that those students will most likely not achieve the meaningful learning that Helldén (2002) is referring to.

During my observations in England and in Sweden I noticed that the teacher is constantly directing the students towards more scientific knowledge, and the key words that the students need in order to express their scientific knowledge. According to Lundqvist (2009:12) the way that the teacher conveys the subject content to the students is referred to as the "manner of teaching". Lundqvist (2009:46) and Lidar (2010) claims that one way of conveying the subject content to the student is by acting as a *epistemological direction provider*, where the teacher uses: *confirmation, reconstruction, instructing, generating and reorientation*. Further ways that the teacher can direct students towards the appropriate knowledge is by using what Lidar (2010:34) refers to as *privileging*. Privileging is where the teacher can demonstrate to students what ways that would be reasonable to take in order to retrieve the appropriate knowledge. Privileging is very commonly used at Sixth Form in England where the teacher has neither time nor room to focus on any other content than the appropriate one for the course. The teachers in England have never time to address any current events or anything that is not included in the curriculum due to the limit of time. The teachers in Sweden use privileging in order to direct students towards the appropriate knowledge for the lesson and for the course. However, in comparison with the English teachers, they have more time to address other information besides the subject content that is included in the Swedish curriculum. One could argue that this could stimulate students' questions, their interest, motivation and learning of science.

The students in England felt that they were under a lot of stress concerning the

exams and that they were under a lot of pressure to accomplish during the exams. During my observations I noticed that the teachers were very focused on the faults and errors in the students' answers, what is referred to as the *red pen mentality* by Hofvendahl (2010). Instead of focusing on the correct answers where the students had achieved full points the teacher focused on their faults and mistakes despite that their flawed answers were fewer than the correct ones. Thus the teacher chose to shed light on the students' faults instead of encouraging and congratulating them for their correct answers. Compared to English students, the students in Sweden felt much less stress before their exams. This was presumably due to the fact that they felt that they had plenty of opportunities to demonstrate their knowledge apart from their exams. Furthermore during my observations in Sweden I did not come across any teacher behaving in the way that could be classified as red pen mentality.

6.2 Students' learning

The students in England were, according to my observations, always asked to work individually during the lesson, without any collaboration with other students. Whereas in Sweden, the teacher often encouraged the students on working together during the lesson in order to help one another. Thus the English school system is based in an individualistic approach also known as constructivism approach to learning. Whereas the Swedish school system is mainly based on the sociocultural approach to learning as well as some traces of constructivism. However, neither in England nor in Sweden the teachers addressed students' everyday knowledge or anchored science issues in students' everyday experience as recommended by Dimenäs (1996).

According to Helldén (2002:228) a teacher must address students' everyday knowledge in order for them to successfully acquire scientific knowledge. During my observations I did not observe a single occasion in neither England nor Sweden where the teacher addressed students' everyday knowledge. Addressing students' everyday knowledge is a mean in order to guide the students towards more scientific dimensions. Also to make the students aware of their everyday knowledge and for them to develop their everyday knowledge towards a more scientific one. Evidently, not addressing students' everyday knowledge would have an immediate effect on how well they acquire scientific knowledge and how well they move towards scientific dimensions.

Learning by interacting with others is necessary according to the sociocultural theory [Lundqvist (2009), Lidar (2010), Andersson (2001), Säljö & Wyndhamn (2002), Östman (2002) and Helldén (2002)]. It is by interactions with others improves our understandings and develop knowledge.

The most common teacher - student communication that I observed in England was when the teacher asked the students a question. After that the teacher would go through the correct answer and then ask the students to compare their answer to the teacher's answer. Communication in the Swedish classroom was different, the teacher was providing the students with instructions in order to work on their own or in pairs, most often in pairs. Thus the teacher allowing the students to communicate science amongst themselves, something that I never saw during my observations in England. Östman (2002) claims that the most common communication in the classroom is when the teacher is the one asking all the questions and students are the ones that answer. This kind of communication stands in the way of students' learning. He argues that students should be given many opportunities to communicate science amongst themselves, and also encouraged to discuss their own questions and thoughts with the teacher.

According to my results, the amount of subject content that is explained in the curriculum in England (see table 2) is more detailed and quite extensive in comparison to the content in the Swedish one. During my observations I could clearly see that in

England the time limit had negative effect on both teachers and students.

Dimenäs (1996:21) argues that substance crowding is catastrophically for average students since the only possible way for learning is to memorise something without any understanding of the significance of it. In the end this will result in the students losing their motivation and their interest in science. This could prevent them from study science at university. Students should instead be given opportunities to discuss and argue about a content and at the same time to develop their communicative ability (ibid). Thus, students in Sweden will more likely attend science study at university due to the less prominent *substance crowding* in science education.

According to Klapp Lekholm (2010) the idea behind having exams as the main assessment of students' knowledge is problematic. This is due to that there are other aspects that can affect the outcome other than the student's knowledge, for example nervousness, lack of sleep etc. Moreover it is better for students to experience assessments over a long period of time where the assessments are spread out over several occasions that involves other methods besides exams. The exams in England is not a fair representation of their true knowledge due to the other aspects that can affect the outcome of the exam. In comparison to the assessments that take place over a long period of time in Sweden that evidently benefits the students concerning the assessment of their science knowledge. Thus the results from the exams, that were the main form of assessment observed in England do not probably mirror students' true knowledge compared to results from the assessments that take place over a long period of time in Swedish schools, that should be more adequate to students' science knowledge.

English students were satisfied with the fact that the teacher is only responsible for a fifth part of their grade and that the rest is decided by their exam results. They argued that the teacher is subjective and that the grade depends too much on whether or not the teacher likes you more than how well he/she assessing their knowledge. Moreover the students in Sweden claimed that there were times when the teacher had set an unfair grade due to their dislike of student's personality or attitudes. Although the students in Sweden found it to be problematic with the teacher setting the grade, they did not approve of the idea that exams would be the main assessment that would set their grade, as it seems to be a situation in England. Although it is not allowed for the teacher to take into consideration the student's personality and attitudes when deciding their grade Korp (2010) argues that this is unfortunately reality. Korp (2010) claims that teachers in Sweden take both student's absence and late handing in of assignments for evaluation even though this is not included in the grading criteria. Therefore it could be argued that some of the grades that students in Sweden receive is subjective and incorrect. Whereas the grades that the students in England receive are more objective but not always representative of students' scientific knowledge due to the other aspects that can affect the outcome of the exams.

Illeris (2007) claims that the English speaking countries, England included, have more of a *self-directed learning* whereas the Nordic countries, Sweden included, have more of a *peer-directed learning*. Thus students in England have higher expectations at being independent and being responsible concerning their own learning. Whereas in Sweden the students alongside with the teacher and other people are together responsible for students' learning. Therefore the demand for independence is less prominent for students in Sweden than what they are for students in England. Independence was something that the students in England claimed that one must have when studying at Sixth Form in England otherwise it would become very difficult to achieve A levels. Whereas the students in Sweden claimed that although Sixth Form required more independence from them than during secondary school, the pressure of being independent at Sixth Form were not that prominent.

Consequently if a student lacks in independent qualities studying at Sixth Form in England would become difficult whereas studying in Sweden would become less

challenging. Therefore it could be argued that students that need extra support in their science education would benefit from studying in a Sixth Form in Sweden, compared to in England concerning the level of independence that students are required to have.

6.3 Consequences concerning Science Education

After seeing the students in England working independently and seldom being allowed to work together I began to question just how much the students actually learned as a result from that educational structure. From the sociocultural approach I would argue that it is by socialising, questioning, debating and discussing with others that our knowledge expands. On our own we can only learn to a certain extent but together there is no limit to how much our knowledge can develop, together we can retrieve a new perspective. Although working in pairs or in larger groups is important for students' learning, one cannot forget that working independently is also essential concerning retrieving new information. Science education needs to be a mixture of students working both independently and together with others, thus students need a mixture of the sociocultural approach combined with the constructivism approach in order for students to learn meaningfully. Therefore one would encourage teachers both in England and in Sweden to try and to combine the two working methods in science education, due to the fact that the educational structure in the classroom will affect students' learning and their potential to learn science during lessons.

According to Dimenäs (1996) every new information that one comes across is categorised and accommodated or assimilated to the already existing knowledge and this is how our knowledge develop. In order to achieve meaningful learning students need to be aware of their own knowledge before they can cross the border from everyday knowledge to more scientific one. Therefore the teacher needs to address students' everyday knowledge before introducing the scientific conceptions otherwise the concepts will simply stand on their own and without the opportunity to connect to students already existing knowledge. Due to the time limit concerning science education, the teacher has seldom the possibility to do this, furthermore the teacher probably does not realise the importance of addressing students' everyday knowledge. If we, as teachers and soon-to-be teachers, want students to achieve life-long learning, we ought to adjust the teaching so that students can become aware of their everyday knowledge and that this knowledge has to be challenged. I admit that addressing students' everyday knowledge and challenging them takes time but I would argue that it is what it takes in order for students to achieve life-long knowledge.

The difference between the extensive detailed curriculum in England and the quite general curriculum in Sweden is mainly in the amount of subject content and the level of detail. The problem with the curriculum in England is that with about 30 pages of subject content, time becomes the major issue concerning science education. Consequently with focus on having time to address every little detail in the curriculum, students' learning comes second and preparing students for the exams comes first. Whereas in Sweden the problem with the curriculum is that there is much room for teachers to interpret what subject content that should be addressed and to what extent. Which results in that science education differs, depending on what teacher one has and to what school one goes to. Thus students in Sweden receive different science education, which is by contrast to the school's assignment from the government where students have the right to receive an equivalent education regardless to where they receive their education.

In terms of the curricula I would claim that they both have their strengths and their weaknesses and that the best for students' learning would be to come up with a curriculum that would be a mixture of the one from Sweden and the one from England. Due that the curriculum in England is too specific concerning subject content which

stands in the way for students' learning. In addition the curriculum in Sweden is too general as regards to subject content which results in students not receiving a equivalent education regardless of where they study. From the teachers point of view the curriculum in England is a major time issue for the teachers concerning the planning and constructing of science education. Whereas the curriculum in Sweden is a challenge in deciding on the extent on certain subject content and on what aspects to work with from a particular science topic. The challenge for teachers in Sweden is also to gather enough assessments of students' knowledge to set their grades. Whereas in England teachers can assess a fifth of students' grade which is based on students' practical skills or they can send their assessments to the examination board.

7. Conclusion

7.1 Conclusion

In conclusion what the comparison between science education in England and in Sweden clearly demonstrates is that science education differs in these two countries. Different in terms of the curriculum concerning the extent and detail of the subject content, the educational structure in the classroom and how teachers experience teaching science. In addition the comparison clearly shows that science education, in English and Swedish school respectively, could possibly have different effects on students' learning and on how students experience this education. These differences can be caused by different content in the curricula for science education.

The curriculum in England is extensive and highly detailed which leaves little room for teachers to incorporate any other topics or information that is not specified in the curriculum. Whereas the curriculum in Sweden is constructed with science topics and what aspects concerning subject content that should be addressed is for the teacher to decide. Thus teachers in Sweden have more freedom concerning planning and executing the subject content in science education at Sixth Form than the teachers in England. The educational structure in England mainly consists of the students working independently and not being able or allowed to work together. Whereas in Sweden the students are often encouraged on working in pairs or smaller groups. The teachers in England experience the science education to be very stressful and that there is a time issue with having enough time to address all of the subject content before the exams. They feel that they have no freedom as regards to the subject content in the curriculum. The teachers in Sweden are not as stressed concerning subject content but more about having enough material to make a fair assessment when setting students' grades. Also that they feel freedom as regards to deciding what subject content to address within a specified science topic in the curriculum.

The main focus for the students in England is to perform well on their exams due to the fact that their grades are mainly based on their exam results. The possible effects that science education in England could have on students are that students lose their motivation to study science due to the substance crowding. The main focus for the students in Sweden is to show the teacher that they have acquired scientific knowledge and that they can demonstrate it throughout the science course. The possible effects that this can have on the students is that they feel pressured in showing the teacher what they know although they have several occasions to demonstrate their knowledge. The students in England experience their science education of being very stressful, where they feel pressured to achieve good results at the exams. Whereas the students in Sweden are more concerned with showing the teacher what they know and to establish a good relation with their teacher which will, according to them, improve their grades.

7.2 Further research

If one were to further investigate the effects that the governing of the subject content in the curriculum in science education have on students' learning process, consequently it could have an immediate effect on how science education is conveyed. As well as affecting the way that the curriculum is presented and what subject content that is included in the science curriculum. Above all, further research could allow us to retrieve a clearer view of students' learning process in science and how science education could be improved in order to better suit students' ability to acquire scientific knowledge.

7.3 Critical evaluation

I choose to compare the Swedish curriculum for science 1b and 2 with the English curriculum for physics, chemistry and biology at Sixth Form. One could argue that it would have been a more valid comparison if the English curricula would have been compared to the Swedish curriculum for physics, chemistry and biology. Although I chose to compare to Swedish science 1b and 2 to the English curricula due to the fact that, at that time, I was not aware of the structure of Sixth Form in England as regards to subjects to study. After my visit to England I realised that a comparison between the Swedish curriculum for physics, chemistry and biology and the English curriculum for physics, chemistry and biology would probably have been a more valid comparison than my study presented here. But I would argue that my analysis of the educational structure of science and the effects that the governing of the subject content in the curriculum have on students' learning process is still be valid. This is due to the fact that the differences between science education at Sixth Form in England and in Sweden is very clear as to what effects it could have on students' learning process. Also as to what effects the governing of the subject content in the curriculum have on both the structure of science education as well as students' learning of science.

Considering that the time provided for this investigation is a total of seven weeks, I would argue that I have a adequate number of interviews and observations included in my study. Although some would argue that there are too few interviews and observations in my investigation, but referring to Esaiasson (2010), the number of interviews and observations are in relation to the amount of time that were available for analysis both before and after the interviews and observations. Therefore the amount of interviews and observations is in direct relation to the time available for analysis before and after.

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Interviews and Observations

	England	Sweden
Interviews with teachers	Wednesday 16 Nov 2011	Monday 28 Nov 2011 Tuesday 29 Nov 2011
Interviews with students	Thursday 17 Nov 2011	Thursday 1 Dec 2011
Observations	Tuesday 15 Nov 2011 Wednesday 16 Nov 2011	Thursday 1 Dec 2011

Appendixes

Appendix I - Interview Questions for the teachers in England

1. What are your views on the syllabus of biology/chemistry/physics?

- Pros and cons from your point of view?
- Pros and cons from the students' point of view?

2. What are your views on the A level exams?

- Pros and cons with the exams from your point of view?
- Pros and cons with the exams from the students' point of view?
 - When it comes to their learning?

3. What do you think would have been different if:

- The teacher would construct and correct the A levels exam?
- If the student's grade would fully be based on the teacher's assessment?

Appendix II Interview Questions for the teachers in Sweden

1. What are your views on the Science syllabus?

- Pros and cons from your point of view?
- Pros and cons from the students' point of view?
 - In terms of their learning?

2. What are your views of the fact that the teacher is fully responsible for the student's assessment and final grade?

- Pros and cons with this way of teaching from your point of view?
- Pros and cons from the students' point of view?
 - In terms of their learning?

3. In England, the teacher is only responsible for 20 percentage of the student's both assessment and final grade, the remaining part is performed by the Examination board.

- How would this change the teaching in your classroom?
- Pros and cons with this way of assessing the students from your point of view?
- Pros and cons from the students' point of view?
 - When it comes to their learning?

Appendix III Interview Questions for the students in England

1. What do you think the main differences are between studying at secondary school in England compared to studying at Sixth Form in England as regards to studying either 12 or 4 subjects simultaneously?
2. What do you think about the AS and the A level exams?

-What is good about them and what do you dislike about them?
3. Due to the fact that your grade is 80 percentage based on the exams, what do you think about if the grade would be based 100 percentage on the teacher's assessment?

- Or if the grade would be based 50 percentage on the exams and 50 percentage on the teacher's assessment, what do you think about that? Would that work/not work?

Appendix IV Interview Questions for the students in Sweden

1. What do you think are the main differences between studying at Secondary school and studying at Sixth Form College?

2. What do you think about the fact that the teacher is fully responsible for all of the assessment and of the final grade?

- Pros and cons?

- In England the teacher only stands for 20 percentage of the final grade;

- Would that be to your gain or to your loss? Why?

3. In England, the students read four subjects over a period of two years.

- Is this something that you would have preferred? Why / Why not?

- What pros and cons can you see with that form of structure?