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Building a Science Region

Youth's Visualization of Science

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Abstract

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Regions around the world are distinguishing themselves from others through investing in specific fields to bring recognition to itself and maintain competitiveness on the world stage. With the upcoming European Spallation Source and MAX IV laboratories being built in Skåne, planners and politicians are working towards transforming the region into a science region. Those working for the regional government, Region Skåne, are creating and implementing strategies for the future and it is the children and youth living in the region who will be most affected by the decisions made for the coming years. To those in government, young people are seen as the generation that will embody the ideals of the region and the ones who will perpetuate the notion of a science region. The problem however, is that the region and young people do not understand each other. Region Skåne is promoting ESS MAX IV and material sciences as the specialization of Skåne, while youth have different definitions, interests, and opinions on the field of science and the future. A project based on visual ethnography was conducted for Region Skåne that involved asking 19 pupils to take photographs of what science is to them and where they see science in their everyday lives. The aim of this research is to demonstrate how youth in Skåne understand, perceive, and portray science through their photographs. These visualizations of science are tools that may contribute to region building and including youth in developing a science society. To analyze and make sense of the youth's photographs of science, this thesis is grounded on the theoretical concepts of constructionism, signs, habitus, and life course theory. The photographs communicate that some youth are contemplating careers in the sciences in the future, that asking questions is a way for them to engage with science, and that the photographs are a reflection of how a young persons understanding of science is influenced by their background and upbringing. In order for children and youth to feel a sense of belonging in the science region, the region needs to understand how youth understand science and collaborate with them in developing the science region.

Keywords: region building; youth; visual ethnography; perception of science; science region; participation; inclusion;

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Chapter 1: Introduction and Background

1.1 Introduction

On the evening of December 1st, 2011, a photo exhibition was held by Region Skåne at an art gallery in Malmö, featuring photographs taken by 19 children and teenagers, all under the age of 16, living in Skåne, the southernmost county in Sweden. My colleague Raakesha Francis and I were working as interns for Region Skåne and we conducted the fieldwork for this exhibition we titled, "Snapshots of Science: Exploring new perspectives on ESS (the European Spallation Source) MAX IV (laboratories) through the everyday lives of Skåne's youth". Photographs of what the youth interpreted as science and where they saw science in their everyday lives were displayed. Civil servants, politicians, and the Regional Chairperson from Region Skåne, the governmental body for the county of Skåne, attended this event along with a number of the pupils who took part in this project. The purpose of the exhibition was to demonstrate to those in government how and what youth were thinking about science, a topic that the government is currently working with in light of the European Spallation Source and MAX IV laboratories being built in the region. To encourage interaction at the exhibition, selected photographs were categorized according to topic and placed on the wall along with quotes from the students regarding their images. Furthermore, technology in the form of iPads was used to display more quotes from the pupils and featured images from the 4 schools that took part in our project. And lastly, a large chalkboard wall was utilized to encourage those in attendance to write or draw and share what their own individual idea of science was. Different reactions from those who were at the event arose throughout the evening. From civil servants who were surprised that youth took photographs of an atomic bomb to convey the dangerous effects of science to a 14 year-old girl being excited that a politician mentioned one of her quotes from the exhibition wall in one of the speeches that evening. The exhibition created a space for both politicians and young people to meet, interact, and share what their understandings and definitions of science are and also provides the backdrop to this thesis.

Regions are becoming powerful actors. Although the nations in which they are situated are important, influential regions are emerging around the world with a specific focus, specialization, or expertise. Terms such as "innovation corridors", "science cities", and "smart regions" have been used to describe areas that excel in science, information technology, or for its strong reputation in education to name a few examples (Couchman, McLoughlin, & Charles, 2008). Regions in the same country, continent and around the world are taking efforts to stand out and differentiate themselves from others. Gunnar Törnqvist (2002) uses the term "region building" to describe the "situation where local and regional forces consciously strive to create a new region or perhaps more accurately try to strengthen an already existing but underdeveloped regionalism in an area" (p. 83). Furthering

this, Anssi Paasi (2009), a professor in Geography, suggests that today, regions are created with the "aim [of] developing or increasing the competitiveness of the spatial unit in question" (p. 133). This notion of region building can be identified in a global trend where countries are investing in the study and application of scientific knowledge in specific territorial areas and facilities to strengthen its attractiveness and competitiveness on the world stage (Isabelle & Heslop, 2011). Today, region building through investment in the sciences is used as a tool to create a competitive region that is expected to bring benefits to its economy and its residents.

The government is making decisions to develop a region so that it will one day become what the politicians and civil servants envision it to be. While regional planners are making decisions, youth living in these places are also planning for their individual futures. Planners and politicians are creating strategies and making predictions for the future and it is the youth growing up and living in these regions today that will be affected by the decisions made for the forthcoming years. In terms of region building, young people growing up in a science society may be seen as a new generation that embodies the ideals of the region and therefore be seen as a human resource for planners and thus fuel their interest in understanding young people. Identifying with a science region however, is not a given. In order to create feelings of belonging to this ideal region projected by planners in government and for youth to contribute to the embodiment and perpetuation of the region, it is necessary to understand youth perception of science today and include them in the region building process in order for both parties to benefit in the potential benefits that come from the development of a competitive, science region.

Furthermore, the 1989 UN Convention on the Rights of the Child (UNCROC) encourages, and requires those working in local governments to engage with children and youth and to listen and respond to what this group has to say on matters that affect them and the development of the communities they live in (Freeman & Aitken-Rose, 2005, p. 227). Several articles in the UNCROC communicates how children's rights are applicable to planning including their right to freedom of expression (article 12), to meet others (article 15), for actions taken concerning the child to be in their best interest (article 3), and the right to education for personal fulfillment and responsible citizenship (article 29) for example (Freeman & Aitken-Rose, 2005, p. 228). Adults, and in this case planners, are the ones who have the responsibility to engage and encourage the participation of youth in the building of the region.

1.2 The Problem and The Aim

There is a lack of understanding on how youth are thinking in the work that the region, both planners and politicians, are currently engaged in. As Kathryn Frank (2006) states, "[b]ecause youth

are rapidly developing – physically, psychologically, and socially – public decisions about city design, economic development, social services, and environmental quality affect youth to a large degree, and the effects carry over into adulthood. Planning has far-reaching implications for youth because they are the generation that will experience the results of the decisions the longest" (referencing Lennard & Lennard; Chawla, p. 351-352). Planners are making decisions that will have the most direct impact on youth who will become adults in the following years, while young people are making decisions and following their own agendas. Currently, regional planners and young people are both planning for the future without understanding each other, as youth are not often included in dialogue with this group of adults. At Region Skåne, planners are working towards promoting ESS MAX IV and material sciences as the focus and specialization of Skåne and are looking into the future as to how these facilities will benefit society and the future users, being the youth, in particular. Youth on the other hand have different definitions, interests, and opinions on the field of science and their futures. Through the visualizations of science that has been collected from a group of pupils in Skåne, how youth think about their futures, the subject of science, and the plans they are making for themselves is communicated and is a resource for the region and its leaders. In order for the young people in Skåne to identify and feel a sense of belonging to this emerging science region, their perceptions of science need to be brought forth and recognized in order to contribute to building a region that will resonate with the youth growing up in this society.

The aim of *Youth Representation of Science* is to demonstrate how youth in Skåne understand, perceive of, and portray science through photographs and how this information is useful in aiding the work of the region. Photographs provide visuals of what youth are thinking in regards to the word, science. As what youth know and how they think about science differs from the concepts civil servants and politicians have in mind suggests that there is a need for planners to work more actively with youth in order to include them in the building in order for them to feel as if they belong and contribute to the perpetuation of this science region. The visualizations of science that will be presented and discussed in this thesis can be seen as tools that contribute to region building and youth's inclusion in developing this science society.

Over the last two semesters, I have been working on projects for Region Skåne in relation to the European Spallation Source and MAX IV laboratories (ESS MAX IV) and the data that I have collected and will analyze is situated in this context. I will begin with background information regarding the Swedish school system, Region Skåne, and ESS MAX IV so that the reader has this context in mind while reading the thesis.

1.3 Background: The Swedish Education System

Understanding the structure of the Swedish education system is beneficial to recognize where and how children and teenagers in Sweden receive formal science education. From a very young age, pupils have the ability to influence their education in Sweden. Three of the schools that took part in the project "Snapshots of Science" falls under the elementary and middle school category. The equivalent of elementary school and middle school in Sweden is the grundskola. All children between the ages of six or seven and until they are sixteen, are required to attend grundskola and attendance during those nine years of schooling are compulsory (Skolverket, 2011a). In Sweden, the Utbildingsdepartement (the Department of Education) sets the national school curriculum and curriculums communicate the goals and the objectives of each subject (Werler & Claesson, 2007). Tobias Werler and Silwa Claesson (2007) have written about the Swedish education system and they report that in grundskola, "the form and weekly workload are not fixed, lessons may be topically oriented, project-oriented, or even interdisciplinary. Learning objectives are defined only for the fifth and the ninth forms. During the school day, pupils in particular influence the organization of their lessons…[And as] they get older, pupils are continually given more responsibility for their own learning and working at school" (Werler & Claesson, 2007, p. 751-752). Furthermore, each grundskola has its own profile and orientations and it is the parents' decision as to which school is appropriate for their child. For example, a school may have a strong emphasis on English classes or have cultural and sports profiles (Skolverket, 2011b). During the pupils' years in the grundskola, Swedish, mathematics and English subjects are particularly emphasized (Werler & Claesson, 2007). Pupils are exposed to science in the classroom setting from the first grade onwards. From their curriculum for 2011 in regards to science education for those in grundskola, the Swedish National Agency for Education or Skolverket (2011c) in Swedish, highlights the importance of knowledge in the natural sciences for the benefit of society and lists topics such as health, natural resources, energy supplies, material development and the environment as necessary for individuals to be educated in, in order for them to take action in their own lives and in the community.

Like in many other countries, high school, or gymnasieskola in Swedish is available to pupils once they have completed their primary or compulsory education. In Sweden, Skolverket (2011d) suggests that secondary education provides students with a good foundation for vocational work, for further studies at the university level for example, and for individual growth as well as providing a platform for participation in society. Before entering high school, students in their final year of grundskola have many paths they can choose to explore in the next phase of their education. As some of our participants have told us, not only do they need to choose a track or a program to enter, they need to choose a high school, and all of the high schools in Sweden are available to them to enroll in.

Currently, there are 18 national upper secondary programs available for students to enter, with each program lasting 3 years, consisting of foundation subjects as well as being educated in specific courses in their selected field (Skolverket, 2011d). Tracks that are available for students include programs specializing in childcare and recreation, construction and installation, business administration, restaurant and food, humanities, and natural science to name a few examples (Skolverket, 2011d). In their teenage years, high school students in Sweden are making decisions that may potentially influence their post-secondary choices as well as their careers.

1.4 The Position of Science in Skåne: Region Skåne, the European Spallation Source, and MAX IV Laboratories

Skåne is the southernmost region in Sweden. In 2010, there were approximately 1.2 million inhabitants living in Skåne, making up approximately 13% of the Swedish population (Region Skåne, 2010). Region Skåne[1] fulfills the tasks of county councils and they have fiscal authority but do not hold any legislative authority in this area of Sweden (Hammarlund, 2004). Furthermore, the primary responsibility of county councils and Regions is health and medical care, as well as being involved in cultural activities and in local and regional public transportation systems (Hammarlund, 2004). Region Skåne must fulfill the tasks of county councils and are also responsible for the growth and development of the region (Hammarlund, 2004). As they state on their website, "[c]entral to Region Skåne's regional development responsibility is the mandate to serve as the unifying agent and the region's representative, as well as [having the] task of preparing a strategy for long-term development through a regional development plan" (Region Skåne, 2011, para. 1). Region Skåne is the regional actor in the southernmost part of Sweden and it is their mandate to provide immediate services to citizens as well as planning and providing for the future of the Scanian population.

Skåne is frequently associated with the concepts of innovation and science through the resources that are located in the region, as well as through promotion and branding from Region Skåne. In their publication "Innovation Skåne: Thoughts on an International Innovation Stratgey for Skåne", Region Skåne communicates their definition of innovation as "new services, products, ways of working, things that improve society and lots more besides. But an innovation always has to create new value and produce growth" (Skåne Research and Innovation Council & Soundingboard Innovation i Skåne 2011, p. 1). To support their innovation strategy and outlook, Skåne has many resources to draw upon. Located in the region are 4 universities including Lund University,

[1] In Sweden, county councils, headed by a Governor, are elected "to ensure that decisions made by government and parliament are implemented, and to monitor conditions within the county and keep the central government informed of regional needs and requirements" (Hammarlund, 2004, p. 147).

"Scandinavia's largest campus for research and higher education" (Invest in Skåne, 2010a, para. 2). Skåne is also located in the Öresund Region, a cross-border region that includes the Greater Copenhagen area in Denmark, fostering their involvement in transnational scientific networks. On their website, Region Skåne claims to lead the world in research areas including marine and water biology, civil engineering, environmental sciences, nuclear physics and public health for example (Invest in Skåne, 2010a). Furthermore, science parks also contribute to Skåne's science and innovation landscape. Ideon is located in Lund and supports the development of businesses in biotech and IT and Medeon in Malmö, supports research and companies in bioscience and medical technology (Invest in Skåne, 2010b). According to the definition of innovation provided by Region Skåne and as demonstrated by their investment in education and research, science is a driving force of innovation in that research leads to new developments and answers that may have great effects on society.

The European Spallation Source (ESS) is a project co-hosted by Sweden and Denmark, as well as being funded and co-hosted by 17 European countries, is currently being built in the city of Lund in Skåne alongside MAX IV laboratories, which is funded by the Swedish Research Council and Lund University (European Spallation Source, n.d.b). ESS and MAX IV will be built on the same site and it will become a large-scale research facility similar to CERN in Switzerland and J-PARC located in Japan (European Spallation Source, n.d.a). From his research on the impact of the ESS in the Öresund region, Törnqvist (2002) explains that these facilities will be used to scatter neutrons in order to study the structure and dynamics of matter" (p. 30). Research on condensed matter has implications for disciplines such as physics, chemistry, material science and biology to name a few (Törnqvist, 2002). The research at ESS MAX IV will also be applicable to many fields of applied science ranging from environmental engineering to pharmaceuticals for example (European Spallation Source, n.d.c, para. 3). Törnqvist (2002) emphasizes the effects that ESS will have on scientific research and suggests that "[t]he role of the ESS in relation to research into condensed matter will in some respects be comparable to the impact of the Hubble Space Telescope in astronomy […] the new scientific phenomena and technological functions that will be revealed as a result of the ESS studies into condensed matter will create *a new inner universe*" (italics in original, p. 31). ESS, together with MAX IV laboratories is expected to provide researchers with the opportunity to answer questions that they could not before without this new technology and to tackle new frontiers in fields affected by research on condensed matter. ESS MAX IV is a European project physically located in Lund, Skåne and through these new facilities Skåne will be catapulted into the spotlight in Europe and perhaps internationally as being a hub for researchers and businesses working with neutrons and condensed matter. With ESS MAX IV being built in Lund, society in

Skåne will experience changes from infrastructure to the branding of the region in order to prepare for and accommodate these facilities and the effects that will arise from it.

Although ESS MAX IV is not yet in operation, Region Skåne is in the process of preparing Scanian society for these facilities alongside municipalities and stakeholders in this project through the TITA project containing 9 sub-projects. One of the slogans that Region Skåne has taken on is "Society for Science –Science for Society" and demonstrates how the regional government is taking steps towards branding Skåne as a science society (Region Skåne, 2009, p. 5). As they state, "[i]n order to achieve growth and employment opportunities as a result of the establishment of the research facilities [ESS MAX IV], all stakeholders in the region must work together to create the right conditions" (ESS MAX IV TITA, 2011a, para. 3). It is one of the primary tasks of Region Skåne to facilitate the development of the region and ESS MAX IV is expected to have a profound impact on Skåne in various ways, from bringing upgrades in infrastructure to bringing spotlight and attention to this region as they will now host one of the worlds best facilities in this particular research area. The TITA project that Region Skåne is involved in focuses in on creating the right conditions for ESS MAX IV and ensuring that these facilities will bring growth to benefit inhabitants of this region. The 9 sub-projects that Region Skåne is involved in address issues including how to assist international companies and researchers moving to Skåne to work at these facilities, how to disseminate information regarding ESS MAX IV to specific audiences to establish new opportunities, and how the vision of "Society for Science – Science for Society" can be established through collaboration with different groups of society (ESS MAX IV TITA, 2011a). ESS MAX IV has the potential to have a vast and diverse impact on the landscape of Skåne and its people. And it is the responsibility of Region Skåne to ensure that planning in relation to ESS MAX IV will be beneficial to all groups and stakeholders affected by this large undertaking. There is a hype being created around these facilities and it is in this context of ESS MAX IV hype that the project "Snapshots of Science" was made possible.

Even though ESS MAX IV is of great concern and importance to those currently working at Region Skåne, Lund University, and businesses in the area that will be impacted by the research conducted at these facilities, society and youth that I have spoken to in particular do not have much knowledge of what these facilities are, what it is capable of doing, and how their everyday lives will be impacted by these establishments. MAX IV laboratories will not be operational until 2015 and currently, ESS is still in its pre-construction phase and will not be opening until 2019 (ESS MAX IV TITA, 2011b). Construction has not yet even begun for ESS and explanations provided on official websites and documents do not provide a clear and simple understanding to the general public as to what the facilities are for. When Francis and I told principals, teachers and student participants that

we were interested in how youth perceived science because ESS MAX IV was going to be located in this region, the children and teenagers who took part in our research did not have any idea as to what these facilities were. The principals and teachers knew of the facilities, however, most of the principals seemed to be doing Francis and I a favor by introducing us to some of their students, rather than having a genuine interest in our project and how their students could be impacted by taking part in our research in relation to ESS MAX IV and Region Skåne. Perhaps it may be because the facilities are not in operation yet, but because ESS MAX IV will not be fully functioning for a few years to come, it is difficult for the general population to grasp something that is not yet in existence and it is difficult for them to care about something that will take place in the future.

1.5 Overview of "Building a Science Region"

In Chapter 2, previous research conducted on region building, youth engagement and motivation in science, and conducting research with youth will be discussed to position myself amongst these fields and highlight what I will be presenting in this thesis.

A reflection on the methods that were used to conduct research for Region Skåne will be discussed in Chapter 3. The latter part of this chapter will also discuss the stakeholders involved in the project "Snapshots of Science" to reflect on Francis and I's experience working with various gatekeepers and how we dealt with different stakeholders and their interests.

To gain a better understanding of how this case will be approached, the theoretical context that I have to chosen to ground my research and argumentation in will be explored in Chapter 4 and used to answer the following questions. First, what do the photographs of science represent? Secondly, do the backgrounds and lived experiences of youth influence what they know and how they think about science? And lastly, how and why does understanding what youth are thinking benefit and help planners in region building?

In Chapter 5, the data that has been gathered during my internship at Region Skåne in regards to how youth perceive of science will be translated into findings and analyzed. The analysis will weave together the theoretical backing that I have presented earlier and specific examples taken from my research will be used to highlight how and what youth are thinking about within the field of science.

Lastly, Chapter 6 will provide a brief summary of the main findings and arguments made in the thesis followed with recommendations as to how planners in regional government can apply this information to the development of a science region.

Chapter 2: Previous Research

The project "Snapshots of Science" and the data that has been collected from it will be discussed and analyzed in the following chapters and aspects of it touches upon several topics and fields of research, which will be briefly explored in this chapter. The concept of region building, other research conducted on pupil's interest in science, and working alongside youth in the research process will be discussed to situate my work and how it relates to these subjects.

2.1 Region Building

The term "region building" may seem irrelevant especially as the borders of Skåne have been established and there is a regional government in place that oversees the administration of public services and the development of the county. Christer Jönsson, Sven Tägil and Gunnar Törnqvist (2000) have pointed out a variety of ways in which the word "region" has been used more traditionally. For example, regions may be formed on the basis of physical geography, cultural regions may come together based on language and ethnic similarity, and functional regions may be understood today as urban centers where there is a constant flow of goods, peoples and ideas (Jönsson, Tägil & Törnqvist, 2000). As mentioned earlier, "new regions" are being formed with the goal of developing or increasing that area or territories competitiveness (Paasi, 2009). In this case, although Skåne has been established for many years, the push for it to be a science region demonstrates that the region is undergoing a transformation.

When asking the question of how to define a region and what constitutes a region, there is no simple answer. From his research, Paasi (2011) has found that "[i]t is common to take the idea of region as a given unit and then analyze social, economic and cultural practices/discourses taking place in these 'ready-made contexts, rather than to theorize and scrutinize the emergence of these contexts as part of broader political, economic and administrative practices. It is also common to understand regions often as 'actors' capable of doing or transforming things" (p. 11). However, Paasi (2011) challenges these commonly held assumptions and argues that regions are social constructs that are formed based on broad social practices and contested power relations, challenging traditional ideas of regions as bounded territories with a distinct essence and identity. To explain the process of region building, Paasi (1996) has presented his theory, the "institutionalization of regions" (p. 32). Briefly, regions need to be seen as historically contingent processes and that "[t]he constitutive powers of regions may originate from the region and from the outside" (Paasi, 2011, p. 12). There are four stages in this institutionalization process. The first stage begins with the development of a territorial shape where the borders of the region emerge from history, or from ad hoc decisions.

Regions then further distinguish themselves through social classification that arises from political, economic, cultural, and administrative practices, and therefore further marking the region (Paasi, 2009, p. 134). Following the demarcation of a territorial shape, symbolic shaping occurs. This is the process of naming a region and creating symbols to communicate the existence of the region and its identity. To support the territorial and symbolic shape of the region, institutional shaping is necessary to put in place informal and formal institutions that produce and reproduce the shape and the symbolic meanings of the region. When individuals and groups interact with institutions, these interactions and practices create feelings of membership and social consciousness of the region forms. The continued presence and contact with these institutions and regional symbols in people's everyday lives leads to the production and reproduction of the region. And lastly, the establishment stage occurs when the region is "accepted as part of the regional system and broader social consciousness" (Paasi, 2009, p. 136). Through his institutionalization perspective, Paasi (2009) is trying to emphasize that regions are a "historical process [combined with] the division of labor and power relations in the production and reproduction of regions: some actors – individuals and collectives like associations, planning bodies and firms […] actively produce regional spaces while others reproduce them" (p. 136). Underlying Paasi's notion of the "institutionalization of regions" is the sense that regions are constructed. Therefore he suggests that it is the symbols, people, and institutions that interact and participate in the making of a region (Paasi, 2010). Regions are not simply put together by leaders and politicians, rather, all actors in society contribute to the building of a region. Regions are produced and reproduced in people's everyday lives and interactions (Paasi, 2010).

Alongside the construction of a region, there is the belief that a regional identity exists. Regional identities are often communicated to demonstrate a difference from other entities, as regions want to stand out and be distinct. As Paasi (2011) has found, "new forms of governance are not only created to manage regions but also to map the most emotional aspects of regional civil society and the minds of citizens to mobilize them as assets in regional development" (p. 139). There are certain actors in society, such as politicians, administrators, business and scientists for example who create a narrative of what the region and its ideal identity is. These actors are making choices "where some elements are chosen to constitute an identity narrative and some others are excluded. Thus, they are expressions of power in delimiting, naming and symbolizing space and groups of people" (Paasi, 2011, p. 14). Regions use their distinctiveness to maintain feelings of identification with the region from its inhabitants, to develop their economy, and to increase its attractiveness to those from outside of the territory (Paasi, 2011). Identification however, is not produced based on similar political ideologies or patriotism for example. In order for those in society to identify with the

narrative of the region, individuals need to have relevant experience with the symbols, ideologies, and narratives communicated by institutions in order to identify with it. Leaders are concerned with creating a unified identity to ensure that the ideal they have projected is a reality. As regions are constructed, produced, and reproduced by everyone within it, it is necessary for politicians, planners, businesses and related actors to understand the experiences of its citizens or create experiences to facilitate and ensure that individuals feel as if they belong and can identify with the region.

2.2 Youth Engagement and Motivation in Science

From my personal experience, science classes such as chemistry and physics seemed increasingly difficult in high school, and as I kept believing that these subjects were difficult, the less interested I became and led to avoiding selecting those classes. This trend of disinterest in science as a pupil goes further in their education that Britt Lindahl (2003) notes is occurring not only in Sweden, but in other European countries as well. Lindahl (2003) conducted research with a group of 80 pupils in Sweden from grade 5 until they were 16 years old and in grade 9 and she found that both boys and girls were becoming more interested in the social sciences and biology which may be correlated with their feelings of success in those subjects (Lindahl, 2003). Furthermore, when girls first encounter the subjects of physics, chemistry and technology in the 7th grade, they feel both uninterested in the subjects and they do not believe that they do well in these classes also (Lindahl, 2003). As they move up in school, girls still have a low interest for these subjects, but feel a little more competent in them (Lindahl, 2003). What Lindahl (2003) has found surprising however, is that the boys in her research similarly reflect how the girls experience and feel towards physics, chemistry, and technology, as gender has been one factor known to impact attitudes and interest in science. Pupils are exposed to science from a young age in elementary school, however, as they get older and into their high school years, their enthusiasm and whether or not they believe they are competent in the sciences begins to decrease.

Several authors have attributed student's lack of interest in science to the little experience they have with what working in sciences is really like. In her research with Swedish pupils, Lindahl (2003) found that students had little experience of science from upper elementary school and their interaction with science comes in the form of experiments in class. As these students enter high school, they expect science classes to be based on experiments, like in elementary school, however, when students are in lower secondary school in Sweden, science is often taught as a lecture where the pupils sit and listen and copy what is written on the board (Lindahl, 2003). The less interactive and hands-on nature of the way science classes are taught in high school are perceived by students as authoritarian subjects where they are expected to only listen and absorb what the teacher says,

contributing to pupils' disinterest in subjects such as physics and chemistry and when they do have the opportunity to do work in a lab, Lindahl (2003) has found that it is already too late to change their perception of science. Jrène Rahm (2007) furthers this by stating that students oppose and become outsiders to the world of science as they have been bombarded by ideas and images in school science that shapes their perception of science a subject that is "socially sterile, authoritarian, non-humanistic, positivistic, and absolute truth" (citing Aikenhead, p. 519). On the other hand, in her study "What do Students Gain from a Week at Science Camp", Deborah Anne Fields (2009) observed that when campers at the Advanced Astronomy Camp were given personal autonomy in the lab, students experienced a sense of responsibility and empowerment through designing their own research projects and the opportunity to use the equipment and technology that professionals in this field use on a daily basis. Furthermore, 9 out of 10 students who Fields (2009) interviewed expressed that they learnt that there was more to science through their experience at camp, than they had previously thought. They were involved in the process of doing science from formulating a research question to collecting data and conducting analysis on their results and through their involvement in the research process, "many [campers] expressed a greater sense of respect for science [and] as a result, [found] school science over-simplified" (Fields, p. 163). As Lindahl (2003) and Fields (2009) demonstrate, classroom learning regarding the theories and laws of different topics of science is necessary, however, without applying and practicing what they have studied, students may easily lose interest in the subject as they do not see the bigger picture of how what they have learnt is useful.

Youth are more motivated to study and pursue a future in sciences when they have established personal connections with the subject and the field. From their research on youth engagement in organized youth programs, Nickki Pearce Dawes and Reed Larson (2011) has identified three types of personal connection that leads to engagement, in their case, with programs and organizations. Youth become more engaged when they "[discover] linkages between the knowledge and skills they were gaining […] to meaningful visions of a desired career or other long-term personal goals" (Dawes & Larson, 2011, p. 266). Dawes and Lawson (2011) suggest that when youth realize and internalize the value of a program or an activity and build connections between what they are participating in and their future goals, genuine interest may develop, leading to desires for deeper learning. Additionally, personal connections "to a purpose that [transcends] the self" may facilitate engagement in youth (Dawes & Larson, 2011, p. 266). As Lindahl (2003) has noted, career goals were one of the reasons the pupils she interviewed chose sciences in upper secondary school. Another aspect of personal connection to science is that pupils rarely have the opportunity to meet and work alongside professional, working scientists. In his research, Rahm (2007) asked students to

draw what they thought scientists lokoed like and he found that most of their images communicated commonly held ideas of scientists being people who wear lab coats, glasses, and at times with eccentric hair, someone that the students do not see themselves as or perhaps being. From Rahm's (2007) observations, he found that students could form personal connections to science through meeting and talking with scientists, which may cause students to reflect on their own position and understandings of who scientists really are and what they actually do. Pupils begin dreaming of future careers and formulating notions of what those careers entail from an early age, as well as setting goals and conjuring up ideas of how they can contribute to society, as they get older. Meaningful experiences and connections need to be made with science beyond what is taught in the classroom in order to motivate and engage young people in studying, pursuing a career, or just to spark their interest in this immense field.

2.3 Conducting Research with Youth

Roger Smith, Maddy Monaghan, and Bob Broad (2002) have observed that organizations and governments are recognizing that they need to have a better understanding of what young people need. Rather than adults studying children and youth and then determining what is best for them, there is a growing trend to include young people in the research process, especially when the issue or topic being studied concerns this group (Smith, Monaghan & Broad, 2002). As stated in the UNCROC, "all actions affecting children's lives (including research) must be based on an approach to children as fellow humans and active citizens (Brembeck et. al. referencing Powell & Smith, 2010, p. 68), suggesting that children must be "involved, informed, consulted and heard" (Brembeck, et al., 2010, p. 68). Children have the capacity to contribute to research and their participation in the research process may lead to greater insight and understanding on the topic being studied, especially when it concerns this group.

In their research on children's food habits, Helene Brembeck, Barbro Johansson, Kerstin Bergstrom, Sandra Hillen, Lena Jonsson, Eva Ossiansson, and Helena Shanahan (2010) included children in their research as "co-researchers". Rather than doing research on children, they wanted to do research with them (Brembeck, et al., 2010). The starting point for Brembeck et al.'s (2010) research began with the children, what they were interested in and what their questions were about healthy eating and physical activity. To begin, they asked questions such as "What is interesting for them? […] How do they learn about what they are interested in? How do they compile and present their research? How do they propose and visualize changes?" (Brembeck et al., 2010, p. 67). Rather than studying children, when children and youth are co-researchers, the research process begins with the questions and concerns of these young people.

Although one may easily see the benefits and value of involving children and youth as co-researchers, how youth are looked upon affects the movement of participatory research. As Brembeck et al. (2010) outline, how children are viewed influences their contribution to research. From a traditional perspective, children are seen as being dependent on adults because they are still growing and developing, and therefore, they are incompetent and vulnerable and need the protection of adults (Brembeck et al., 2010). Another perspective is to see children as "beings" or "subjects with their own desires, thoughts and life-worlds" (Brembeck et al., 2010, p. 68). With this approach however, Brembeck et al. point out that "children in many cases tend to become essentialized to residents in their own worlds, separated from adults. Children are seen as valuable but different" (p. 68). Rather than viewing children and youth as dependent and as an isolated group, Brembeck et al. (2010) have chosen to view children as social actors whose lives are shaped by "time, place and social environment" (p. 68). Following this approach, children are seen as capable individuals who are able to take care of themselves (Brembeck et al., 2010). When children are viewed as social actors, this group in society needs to be acknowledged as active citizens who need to be included in the public sphere from participating in research to taking part in larger scale projects such as region building.

Participatory research involving youth has benefits for all the parties involved. As Smith, Monaghan, and Broad (2002) have pointed out from a project they conducted to understand the health needs of socially excluded young people, they found that youth benefited from taking part in the project because they experienced feelings of empowerment and inclusion, while their involvement helped the leaders of the project and those in the health industry better understand the research topic. When youth are co-researchers they have the ability to influence the direction of the research because the subject matter and the way in which the topic is approached will "be better attuned to the perceptions and priorities of the young people involved" (Smith, Monaghan & Broad, 2002, p. 203). As the youth have are "insiders" to the subject being studied, insights that arise out of the research may provide answers to questions and paint a clearer picture that "outsiders" may not be able to uncover and fully realize on their own. Furthermore, Smith, Monaghan, and Broad (2002) note that when "young people [feel] a sense of involvement, and some control […it] is also likely to help with this task of encouraging engagement and commitment" (p. 195-196). There is a reciprocal cycle occurring when children and youth are involved as co-researchers. When youth are invited to participate in research, they may experience feelings of importance as their thoughts and input are being sought out, furthermore, young people's contribution to the research process and the insights and value that arise out of their "insider" perspective benefits the outcomes of the research and increases the knowledge of all stakeholders involved.

Chapter 3: Conducting the Project "Snapshots of Science"

3.1 The Project

Region Skåne has demonstrated and taken action towards building and strengthening the role of science in the region. Their goals for the future of Skåne are clearly illuminated through their investment and involvement in ESS MAX IV and preparations in society for these facilities. In an information brochure they state, "The MAX IV and ESS research facilities will focus the eyes of the world on the Öresund Region. These two facilities […] will be used for advanced materials research, a science from which the whole world will benefit. Equally interesting is the impact the establishments will have on Skåne, the Öresund Region and Sweden in general with respect to growth, jobs and business start-ups" (ESS MAX IV TITA, 2011b, para. 1). To ensure that their aim of developing the region occurs with ESS MAX IV, the TITA projects sponsored by Region Skåne together with the municipalities of Skåne, Lund University and surrounding universities as well as other regional actors, have focused their attention on specific tasks including marketing the region, using ESS MAX IV as an innovation catalyst and using these facilities as a way to grow local and regional businesses to highlight a few. Those working at Region Skåne are supporting the sciences as one way to develop and re-construct the region.

At the start of the project, Region Skåne told Francis and I that they wanted to understand how youth in Southern Sweden perceived material sciences. By wanting us to focus our research on the subject of material science, Region Skåne communicates what their focus is in the broad field of science and their interests are in line with their actions. Region Skåne is particularly interested in the topic of material science as they have made an investment through time, work and money into preparing the region for ESS MAX IV. As it is stated on the ESS website, "[n]eutrons are a good instrument for probing material – everything from molecules and medicines to plastics and proteins" (European Spallation Source, n.d.c, para. 1). As neutrons are present in most things that people see, use, and experience in their everyday lives, ESS MAX IV is not only studying material science, but it has the potential to study anything that contains neutrons, thus widening the scope of what will be possible through these facilities again. The study of neutrons will benefit many aspects of science and the research that will be conducted at ESS MAX IV has the potential to affect the everyday lives of people in Skåne, and around the world. Rather than calling themselves a "material science region", Region Skåne wants to become known as a "science region". A science region may include expertise in material science however using a broad word such as science to name and brand the region needs to be more inclusive of other topics and areas of study within the vast field that is science, especially as the study of neutrons has implications for many areas of science. Some of the youth we worked with were still in elementary school and while most of them were in middle and

high school, their knowledge of science is still developing. Rather than limiting their views of science while they are growing and developing physically, intellectually and as individuals, allowing young people to explore the possibilities within science provides students with the opportunity to experience what is possible through science before determining their own interests within the field.

The goal of the project was for Francis and I to understand how youth themselves perceive of and understand science today, rather than pushing a certain agenda and view of science on youth, to provide Region Skåne with more constructive ways of connecting young people to a science region through relating to what the youth themselves know and what triggers their curiosity. To find pupils to take part in our research, Francis and I contacted different schools within the region in hopes of recruiting participants for our project. To recruit, we used personal connections that both our colleagues and we had to teachers and counselors at schools as well as speaking to principals at directly through reaching them on the phone and through e-mail. Overall, we were able to get 19 students to take part in our research and we collected 248 photographs altogether from the participants. From planning the project, to recruiting students, collecting their photographs, conducting interviews and analyzing the data took 4 months in total. The students ranged in ages from 8 to 16, we had both male and female students take part with the majority of them being females, they lived in different cities and towns in Skåne and studied at different schools and were at varying stages in their education. When we introduced the project to the participants, we asked them to take photographs of science and where they could see science in their everyday lives. We chose to ask them about science in general so that the pupils could demonstrate to us what science was to them. After recruiting students, we spent a month and a half out of our three and a half month internship conducting fieldwork, which included meeting our participants, handing out cameras, collecting cameras and developing photos, and following up through interviews. The youth can be seen as co-researchers with Francis and I and could be seen as being empowered as they would be in charge of and had control over taking their own photographs of science for us. Furthermore, the research that Francis and I would be conducting, were based on the photographs that we receive from the youth. We had to trust our student participants to actually do the research for us. Although we sent them e-mail reminders to use the cameras and to return the cameras to us at a certain time, we could not control whether they completed the task or not. In total, we met with our student participants approximately 3 times. To conclude our project, one of the ways in which Region Skåne wanted to use our research was through displaying the photographs from the pupils in a photo exhibition for politicians, civil servants involved in ESS MAX IV and the students and their families to participate in. In order to put on a photo exhibition however, we first needed to engage students in our project and Francis and I chose to do that through the use of visual ethnography and photography

followed by interviews, a more traditional ethnographic research method, were conducted with students involved in this project.

3.2 Visual Ethnography

Sarah Pink (2007) argues, "methods should serve the aims of the research, not the research serv[ing] the aims of the method" (citing McGuigan, p. 5). In order to get a glimpse into and visualize what young people in Skåne were thinking about as science or what they perceive science to be, we chose to engage in visual ethnography. Disposable cameras were given to the participants and we asked them to take photographs of what they thought science was and where they saw science in their lives. From their own work conducting ethnographic research with photography, Patricia Sunderland and Rita Denny (2007), and similarly to why Francis and I wanted to ask students to take pictures for us, was because "what we see and what we report – as observers, as researchers, as photographers, as theorists – always depends on the experience as well as prior experience, with the theoretical conversation one has in the head as well as with each other, with larger symbolic associations and meanings, with history, with comparison, with context" (p. 305). Although Sunderland and Denny (2007) made that statement as researchers or observers taking the photographs and although it may not seem relevant to our work, the students acted as co-researchers during this part of our research and data collection. When we handed the cameras to them, they became the researchers, they had full control over what they documented and they were the only ones who knew why they were capturing certain images. We were interested in uncovering what the students retained about science from their education, what aspects of science interested them and why, where they could see science in their daily lives, and how their personal backgrounds may influence their perception of science. As we wanted the youth to take something away from this experience as well, we thought the use of photography would allow the young people to think about and reflect on the topic of science and allow them to really discover and define what science was to them personally. Science is a vast field and aspects of it are woven into everyone's lives in so many ways, but how it has an affect on our lives often goes unnoticed or even taken for granted. Through photography, we were able to collect captured images that represented the students' experiences and influences that affected their understandings of science.

Photographs and images can be impactful on their own. Often times, pictures are seen as representing "what is real" (Sunderland & Denny, 2007, p. 281). As Charlotte Davies (2008) points out however, the use of photography may have limitations. The camera lens captures only a limited selection of what a person sees and experiences, the image that is taken is set in a specific time, there may be technical limitations as we had experienced with the students due to unfamiliarity with how

to use the camera or the misuse of it, and lastly, the photographer makes decisions and selects what to photograph reflecting their own ideas and thoughts on the subject (Davies, 2008, p. 133-134). At the same time, we wanted the participants to be selective. We wanted to know their personal opinions, thoughts, and understandings of science. We wanted to see science from their point of views. Furthermore, one problem that we had run into in our project was due to technology. Disposable cameras are available in supermarkets, dollar stores, and in photography stores in Skåne, however, none of the young people who took part in our project had used a disposable camera before. At times, the young people did not understand how to use the flash on the cameras for example, and many of their photographs did not develop. When telling some of the youth that most if not all of their pictures did not turn out and giving them the option to complete the task again, several of them stood out and told us that they wanted to take another camera home for the week or that they would e-mail us photographs that they had taken on their own. For example, Christina[2], a student in middle school said, "I want to be a part of it" when asked if she wanted to take photographs for us, demonstrating that she did see value in what she was participating in (Conversation with Christina, September 30, 2011). Another student Anna took pictures on her personal digital camera and e-mailed them to us following our last meeting with her and some of the additional photographs she took were also a part of the exhibition. As can be seen from the examples of Christina and Anna, conducting "participatory research is beneficial both because of its implicit values (such as empowerment and inclusion), and because it improves our level of understanding of the substantive subject area" (Smith, Monaghan & Broad, 2002, p. 192).

Although there may be limitations to using visual ethnography, these limitations are outweighed by the way in which photography allows for subjectivity. The images that are captured may bring the viewer closer to the photographer and they may get a glimpse into their personal feelings, thoughts and opinions on the topic at hand. As we were trying to uncover what science meant to these students and how it was a part of their everyday lives, although we were not able to experience what their lives are like, the photographs allow us to imagine what the youth were thinking at that point and time through their images. We wanted to know the students' personal thoughts and opinions on science, therefore, we wanted photographs that demonstrated those understandings, which are subjective and may vary from person to person. The photographs provide its audience with an impression of what and how the students think and perceive of science.

Although photographs can be analyzed on its own, follow up interviews were necessary to complement the images that we received and to gain a greater understanding as to why the

[2] All the names of the student participants have been changed

photograph was taken. Furthermore, "[t]he meanings of photographs are arbitrary and subjective; they depend on who is looking" (Pink, 2007, p. 67). The photographs of science that we received from the students may be interpreted and understood in various ways by different viewers, and interviews ensure that the students' intentions and what they wanted to communicate through their photographs would be conveyed.

3.3 Going Beyond the Photographs through Interviews

Individual or group interviews depending on the student and the school Francis and I were working with were conducted with the majority of the participants in our research. At some schools, it was easier for us to meet our participants as a group where they had been excused from class or the group had a free hour in their daily schedule to meet with us. The group interviews also allowed the students to interact with and respond to one another during the conversation. While at two of our schools, because students handed in their cameras at different times or due to school holidays, we had to conduct individual interviews with several of the participants. Both our group and individual interviews were semi-structured. We compiled one set of questions that we asked all of the participants from each of the four schools. The opening questions in the interviews centered on the students and their definitions of science, how their experience was using the camera, and how their experience was taking photographs of science. Following these questions, we asked every student to describe each of their photographs to us and to their peers when it was a group interview, and how the subject of their photograph was science, or how it could be connected back to or related to science. Like Pink (2007), we were "interested in how informants use the content of the images as vessels in which to invest meanings and through which to produce and represent their knowledge, self-identities, experiences and emotions" (p. 82). Because each student had different photographs and the ideas behind their photographs related to different topics or fields within the sciences, semi-structured interviews allowed us to be flexible in asking altered or new questions that we had thought of at that moment in time which related to our conversation. Conducting semi-structured interviews gave us the ability to omit questions that were not relevant to the conversation, it allowed us to ask questions that had just come to mind related to new topics that had emerged, and it gave students the opportunity to expand and elaborate on their thoughts and responses (Davies, 2008, p. 106). On top of that, we also wrapped up the interviews with questions regarding their experiences with learning science in school, what they would like to do in the future and how they would get there, and what their own personal interests were. We were interested in the youth's responses to these last questions as it would provide us with a better understanding of what motivates them, how they develop interests, and how they plan for and what influences their futures.

3.4 Collaborative Attachments

> If ethnography is seen as a process of negotiation and collaboration with informants, through which they too stand to achieve their own objectives, rather than as an act of taking information away from them, the ethical agenda also shifts. By focusing on collaboration and the idea of 'creating something together', agency becomes shared between the researcher and informant. Rather than the researcher being the active party who both extracts data and gives something else back, in this model both researcher and informant invest in, and are rewarded by, the project. (Pink, 2007, p. 57).

When conducting social research, it is necessary to reflect on and discuss the issues that may arise from collaborating with various actors and how their involvement may influence the research. Organizing, conducting the fieldwork, and completing the analysis for the project "Snapshots of Science" involved many actors. The different parties that were involved with the project had different aims for participating, which demonstrated a need for Francis and I to, borrowing the term from Casper Jensen (2007), "[sort] attachments" (p. 238). Jensen (2007) defines sorting as "the practical activity of figuring out how to engage with other organizations, institutions or agendas as part of conducting research" (p. 239) and describes attachments by stating that "no such engagement is innocent, since all actors come packaged with sets of cultural, political and economic relationships as well as institutionally sanctioned commitments" (p. 239). In the following paragraphs, I will be sorting our attachments with the principals and teachers at the various schools, parents, the students, and Region Skåne.

3.4.1 Principals as Gatekeepers

The principals and the teachers that we were in contact with were the gatekeepers that we needed to address first before we could recruit and reach our student participants. As Davies (2008) has noted, for certain groups of people, it is necessary to obtain consent from gatekeepers first, especially in institutional settings such as schools. As neither Francis nor I are from Sweden, we do not have any contacts with any families or friends with children or teenagers at home. Also, as our contact at Region Skåne had suggested contacting principals at various schools in order to recruit participants, we decided to recruit through these gatekeepers. Before reaching students, we had to in a sense, sell our project to principals. We needed to inform them of why we were conducting this research, how it will be beneficial for their school and their students, and emphasize to them that they would be a part of something bigger as the research we were conducting was for Region Skåne. When principals were disinterested or did not see the importance or value of participating in our

research, they did not respond to us and we did not pursue them. Other principals showed enthusiasm towards our proposal and made arrangements for us to come to the school and recruit students on our own, or they had a group of students in mind that they introduced us to. Citing the Association of Social Anthropologies, "[c]onsent in fieldwork studies … is a process, not a one-off event, and may require renegotiation over time" (cited by Davies, 2008, p. 56). Principals were the first group of stakeholders that we needed to receive consent from in order to precede. One of the consequences or results of recruiting participants through principals is that at two of our schools, the principals selected which students they thought would be suitable for our project. We do not know why the principals had selected these students for us. Because the students did not necessarily volunteer themselves and because the principals had their own intentions to select specific students, this is a limitation to our research as the principals may have their own biases or reasons for volunteering certain students over others that we do not know about.

3.4.2 Parental Consent

Similarly to principals, communicating to parents about the project and what their children will be taking part and how their information will be used and then receiving their permission is not only good practice, it is a necessary practice in ethnographic research to protect all parties involved. Parents have "interpretive priority" over their children in different realms such as the "economic, legal, social and psychological" aspects of their lives (Brembeck, et al., 2010, p. 70). As all of the youth we worked with were under the legal age of 18 in Sweden, we wanted to ensure that their parents were informed of and acknowledged that they were aware of their children taking part in "Snapshots of Science". Letters of consent were handed out to all of our student participants and we requested that their parents or legal guardians sign a section of the form and to have the student return that portion to us. We did not have any parents object to their children taking part in our project, some of them even assisted their youth with the photography aspect of our fieldwork and attended the photo exhibition featuring pictures from their youth as well.

3.4.3 What is in it for the Student Participants?

Davies (2008) acknowledges that one of the difficulties for researchers when presenting their project to their participants, is "how to present their research in a manner that is meaningful to their particular audience of participants" (p. 55). First, the students did not receive any compensation for taking part in our project. Rather, we tried to emphasize the positive aspects of working with us. When explaining what we would like the students to do for us, we tried to convey that this would be a good opportunity for them to reflect on their own understandings of science and we emphasized

that their photographs and what they told us would be featured in a photo exhibition that would be attended by those who have the ability to make decisions in regional government. We stressed that this would be an opportunity for the young people to have their voices and thoughts heard by politicians and those in the science community who are working towards creating a science region that they hope will be beneficial and inclusive of everyone in society. Secondly, the students did not have any influence over how their photographs and quotes were used in the photo exhibition, nor in the reports and presentations that were given to Region Skåne. The issue of confidentiality comes into play here. How information from informants is treated and used, as well as considerations of privacy and how anonymity is ensured are all issues within the topic of confidentiality (Davies, 2008, p. 59). As we were holding a public photo exhibition and we needed to give credit to the photographers, the names of each student and school that participated was displayed at the entrance of the gallery. Furthermore, quotes from our interviews were used to supplement the photographs at the exhibition to give viewers a better understanding of what the students were conveying through their images. The quotes that we used were edited when necessary to fix small grammatical errors or to take out speech mannerisms, even though we did not state or identify which student we had used quotes from nor did we identify which student took which photograph. In this way, only the student who had made the statements or had taken the photographs on the exhibition wall would have been able to identify themselves. From her work, Davies (2008) has found that "sometimes [anonymity] is not desired, and research participants may be dissapointed and feel that much of the benefit of participating in the research is lost if they are not identified" (referencing Cassell & Jacobs, Crick, p. 61). One of the aspects we presented to encourage students to participate in our project was that the photographs and what the students told us would be used in a photo exhibition, therefore, ensuring anonymity in this situation was not possible, rather, we needed to credit the students for the work that contributed to our research.

3.4.4 Politcians and Region Skåne

Region Skåne hosted my internship and the project that Francis and I worked on, thus being one of our major stakeholders. In part, our research may be seen as contributing to Region Skåne's work towards building and developing a science region that is inclusive of all members of society, especially young people as they will be the future users of ESS MAX IV, as well as being the group that is most impacted by ESS MAX IV and its spin-off effects. Our work for Region Skåne can be understood by the "enlightenment model" of policy research (Davies referencing Bulmer, 2008, p. 68). "[T]he enlightenment model, sees the purpose of social research as providing alternative possibilities and enlightening policy makers through their interaction with researchers and exposure

to new perspectives" (Davies, 2008, p. 68). Following the enlightenment model, research in this regards is to provide general knowledge that may affect different aspects of the work of those in government. Although Region Skåne was interested in students' thoughts on science in general, they wanted to steer our research in a way that focused on material sciences as that is what a majority of the work at ESS MAX IV will be based on. However, one of Francis and I's goals were to show Region Skåne how only focusing on material sciences may exclude many youth from these facilities. Also, one of Region Skåne's aims is for youth to pursue studies in the sciences and jobs in these fields as the region wants to retain its citizens. Francis and I did not want to steer youth into certain studies, rather, we worked towards demonstrating how ESS MAX IV and the work that will be done there can be made relevant and meaningful to the everyday lives of youth.

Chapter 4: Theoretical Framework

To make sense of the photographs and the interviews my colleague Raakesha Francis and I collected for our work with the project "Snapshots of Science", an introduction and overview of the theoretical grounding I have chosen to apply to our data will be discussed in this chapter. In cultural analysis, theory assists in deciphering the information that has been collected and it adds validity to the interpretations that are being made from the data. With these theoretical concepts in mind, the following chapters will apply and demonstrate how and why these theories are applicable to the findings from "Snapshots of Science".

4.1 Constructionism

As mentioned earlier, regions are constructed and there are many actors in different positions and with different roles in society that contribute to region building. In order for a region to establish itself and for it to sustain itself, it is necessary for individuals living in these areas to contribute to the creation and maintenance of the region. Although politicians, businesses, culture, and the media for example may be able to draw the borders of the region, create institutions, and communicate what the region is, in order for a region to sustain itself, its citizens, the individuals living in these areas are the ones who perpetuate the region through their actions and everyday lives and practices. "From a constructionist point of view, the individual is observed both as one *created* by the situation and the cultural context, and as their *creator*. A human is considered as an active, individual, holistic and intentional creature who, in addition to adjusting to existence, continually recreates the social world" (original italics, Antikainen et. al., 1996, p. 19). The main focus in this constructionist approach is how an individual's "consciousness organizes experience into a meaningful entities" (Antikainen et. al., 1996, p. 19). Drawing on the work of Bruno Latour, Paasi (2010) suggests that "a region = a network = an actor 'that is *made* to act by many others', where those 'others' lie 'inside' and 'outside' the perpetually reassembling sociospatial process that we label as the region" (Paasi citing Latour, p. 2300). Therefore, a region is projected to citizens by authorities and leaders however, the region becomes and only exists when individuals act upon what has been presented and promoted. In order to understand what a region is it is necessary to understand the individuals living and practicing the region.

4.2 Signs

We asked a selected number of students in Skåne to take pictures for us of what they saw as science in their everyday lives and the photographs that we received from the pupils in the project "Snapshots of Science" can be interpreted as a sign and can be understood through the process of

semiosis. To understand the participants and their perception of science, the photographs can be viewed and examined as representations of the pupils. Charles Peirce's theory of signs has been written about in depth by Milton Singer, a professor in anthropology and is the main source for understanding this theory in this thesis (Singer, 1980, Singer, 1984). In his article, Singer (1984) quotes Ricouer who argues that "the personal pronoun is an empty sign that anyone can seize: the pronoun is waiting there, in my language, like an instrument available for converting the language into discourse through my appropriation of this empty sign" (p. 61). The students are the ones who took the photographs, and in this process, they are the object of the images. The subject matter or the focus of the image is an index, icon or a symbol that refers to something else and it directs the viewer of the image to something that they can interpret. For Peirce, semiosis is a process that "[consists] of an irreducibly triadic relation of object, sign, and interpretant" (Singer, 1984, p. 57). The process of semiosis facilitates communication and exchange between the "utterer" and the "interpreter" (Singer, 1984, p. 63). In our example, the "utterer" is the students, rather than using words to communicate, it is their photographs that are revealing. Francis and I as researchers, as well as viewers of the photographs are the "interpreters" trying to make sense of the pictures through the indexes we recognize within them through our own knowledge of what we are seeing.

The content in the images communicate aspects of who that student is. Charles Peirce argues that signs are reflexive and are references of the self and furthers this by stating, "whenever we think, we have [to] present to the consciousness some feeling, image, conception, or other representation, which serves as a sign. But it follows from our own existence that everything which is present to us is a phenomenal manifestation of ourselves […] When we think, then, we ourselves as we are at that moment, appear as a sign" (cited by Singer, 1984, p. 58). In the semiotic relationship, the content of the photographs the pupils have taken may be understood as an icon, index or a symbol that represents characteristics of the individual and what they know regarding the field of science. By capturing photographs of certain "things", the students are connecting themselves to concepts they believe are scientific. Furthermore, Peirce's suggests that symbols have the ability to create other symbols within themselves, he states that, "words [and in this situation things in the photographs] have acquired information; just as man's thought does by further perception. But is there not a difference, since a man makes the word and the word means nothing which some man has not made it mean and that only to that man? This is true, but since man can think only by means of words or other external symbols words might turn round and say, You mean nothing which we have not taught you and then only so far as you address some word as the interpretant of your thought. In fact, therefore, men and words reciprocally educate each other; each increase of a man's information is at the same time the increase of a word's information and *vice versa*" (cited by Singer, 1980, p. 488).

Photographs, symbols, and words are reflections of each other. They are reflections of what a person is thinking and what they are learning and these images, signs and words are needed to communicate one's thoughts and exposure to new signs increases one's knowledge and understanding of what it refers to. The contents of the photographs that the youth have taken can also be seen as a starting point for discussions amongst its audience. What the youth have captured as science may not be the same as what different viewers would necessarily agree with, at the same time however, these photographs may contribute to expanding one's view and allow for different interpretations and perceptions of the topic.

4.3 Habitus

Everyone experiences the world through his or her own filters. What the camera captures is limited to its lens and what can be seen through this piece of glass or plastic. Just as the camera acts as a filter as to what is recorded, people make sense of the world through what Pierre Bourdieu has coined one's "habitus". Pierre Bourdieu argues that the body is a "memory pad" and the body or the "memory pad" is where "learning takes place and is inscribed" (Reed-Danahay, 2004, p. 101). According to Bourdieu (1977), "[t]he structures constitutive of a particular type of environment produce *habitus*, systems of durable, transposable *dispositions*, structured structures predisposed to function as structuring structures" (italics in original, p. 72). The phrase "structuring structures" that Bourdieu uses refers to the social conditions that inculcate and appropriate individuals with "products of collective history, the objective structures (e.g. of language, economy, etc.) to succeed in reproducing themselves more or less completely, in the form of durable dispositions, in the [individuals] lastingly subjected to the same conditionings , and hence placed in the same material conditions of existence" (Bourdieu, 1977, p. 85). Dispositions are the "feelings, thoughts, tastes and bodily postures" (Reed-Danahay, 2004, p. 107) that ooze naturally out of individuals because they are actions, emotions and responses that have been internalized and flow out of people subconsciously. One's habitus is revealed as people are constantly "'processing information' or understanding the world in certain culturally and personally constructed worlds" (Reed-Danahay, 2004, p. 101). To gain a better understanding of the notion of habitus, Norbert Elias (cited by Reed-Danahay, 2004) defines this concept as "'the self-image and social make-up' of individuals, and he described it as 'soil from which grow the personal characteristics through which an individual differs from other members of society'" (p. 104). Following the notion of habitus, a way to understand why our participants took certain pictures can be understood through the concept "funds of knowledge" (Gonzalez & Moll cited by Basu & Barton, 2007, p. 467). This concept is built upon the premise that people accumulate knowledge through their life experiences. Funds of knowledge refers to the

historical and cultural understanding of a particular group of people, it can also refer to experiences and awareness that is particular to a specific family within the greater context of a community (Basu & Barton, 2007, p. 468). Furthering this, "one's funds of knowledge may be evident in what one knows as well as in what one does […] one's disposition toward being a particular way in a given situation can be a outgrowth of what one has learned to value in a situation" (Basu & Barton, 2007, p. 468). Although individuals may not be aware of it, the culture, the values, and the beliefs that they have grown up and been surrounded with has been instilled into them just by being in the environment that they have been brought up in. The habitus of a person is so much a part of him or her that they are not even aware of how it shapes them and how they think and make sense of what is around them. The pupils we worked with ranged in age from 8 to 16 and some of them are still children who may readily accept what they are told while some of the participants are teenagers who may becoming more cautious than when they were a few youngers and simply believing what they were given and are developing skills to make individual and informed decisions. Although the pupils are in different stages of their growth and development, no matter how young or old, the habitus begins to develop when individuals are just young children and as it is so embedded into both their body and the way they perceive their surroundings, the habitus is still an integral part of a person even as they mature.

4.4 Life Course

How is science a part of the lives of young people today, where is it present and when is it a significant or pivotal event in the life of a child or youth? Life can be seen as a course. There may be memorable and impacting events in our lives that may change our path or perhaps we may be walking down a meticulously planned out route that we aim to achieve. Glen Elder Jr. (2000) suggests that the notion of a life course can be viewed "as a theoretical orientation for the study of human development and aging, a theory that incorporates temporal, contextual, and processual distinctions" (p. 50). To define the term, life course "refers to age-graded events and social roles in life trajectories that are subject to historical change. Social transitions make up life trajectories, and they derive meaning from them. Change in the life course alters the trajectory of individual development" (Elder, 2000, p. 50). Scholars and researchers have taken on a life course perspective as it "encourages attention not only to how a given social context relates to a single turning point, but also to consider how each turning point leads to a series of events or experiences, or 'series of contingencies'" (Beattie citing Sampson & Laub, 2011, p. 68). The pathways that individuals embark on "refer to the social trajectories of education, work, and family that are followed by individuals and groups through society. Life transitions are always part of social trajectories that give them

distinctive meaning and form. The multiple trajectories of individuals and their developmental implications are basic elements of the 'life course'" (Elder, 1998, p.1-2). Furthermore, the life course perspective is based on the notion that individuals are continuously developing throughout their lifetime and that life stages cannot be understood independently from each other (Johnson, Crosnoe & Elder, 2011, p. 273).

The saying "youth are the future" is commonly used to encourage investment in the growth and development of young people. Monica Johnson, Robert Crosnoe and Glen Elder (2011) have reiterated the argument from economists that "public investments in early childhood bring greater long-term returns than investments in adolescence" (p. 274). In order to understand why, how and when to invest in young people, it is necessary to understand the principles of life course theory that contribute to understanding human development. First, it is necessary to recognize that "the life course of individuals is embedded in and shaped by the historical times and places they experience over their lifetime" (Elder, 2000, p. 51). The year in which an individual is born has a specific context and history, influencing constraints and options in a person's life and influencing all of those individuals born in that same year and place. Secondly, there is a fundamental bond between the age of an individual and time. The developmental impact of a significant event or a transition in a person's life is dependent on when it occurs in his or her life (Elder, 2000, p. 51). There is a commonly accepted social clock and appropriate age in societies and cultures where there is an expected time for certain events such as marriage, having children and retirement to occur for example (Elder, 2000). The third principle of life course theory is that "lives are lived interdependently and that social and historical influences are expressed through this network of shared relationships. Human lives are typically embedded in social relationships with kin and friends across the life span" (Elder, 2000, p. 51). The lives that individuals lead are linked and interconnected to others around them, and as a result, it is necessary to acknowledge that human development also occurs amongst multiple, interlocking relationships (Elder, 2000, p. 52). And lastly, the fourth principle argues that individuals have a constructionist role in shaping their own life and its course. Elder (2000) states that "individuals construct their own life course through choices and actions they take within the constraints and opportunities of history and social circumstance" (p. 52). The course of a person's life is influenced by historical context and place, timing, relationships and by their own construction. It is necessary to understand these four elements and aspects when interpreting and making sense of significant events and transitions in a person's life and when trying to comprehend a person's life course. The theories discussed in this chapter provide a glimpse into what the findings and the analysis will reveal.

Chapter 5: Findings, Analysis & Discussion

5.1 Representation of Science

"Science is everything." This statement was made by an 8 year old girl who was also the youngest participant in the project (Interview, October 14, 2011). As science is so prevalent in society today, it is necessary to understand how it is interpreted by different groups, and in this case, youth living in Skåne. What do youth define as science? What do they see as being science? How is science important to their everyday lives? Science has contributed to many if not all aspects of our lives and the youth we worked with were able to communicate to us what science was for them, and more importantly, what aspects of science were important to them and what triggered their curiosity and why.

From the 248 photographs that were collected in the project "Snapshots of Science", 5 themes and topics of what youth understand and associate with the word science emerged. The subject of the photographs could be placed in the following categories: nature, advancements, big questions, evil and danger, and materials. Even though the students all took their photographs individually, similar subjects arose when looking at all of the pupil's visualizations demonstrating that these young people have similar conceptions of science. Youth in Skåne today are concerned about the environment and know that they can have an impact on sustainability through their photographs of bicycles and a recycling station at their home for example. In the category of advancements, students captured how society has moved forward. For example, there were photographs of clean water flowing out of taps, airplanes, and tram tracks running through a city. Some of the adults who attended the photo exhibition were surprised to see that students also associated science with danger and being evil. Young people are now more aware of the consequences of science and the participants captured images of household products that contain chemicals, and sugar and candy as they can be detrimental to ones health. Under the heading "big questions" is photographs of questions that the students were asking. For example, there is a photograph of an iPod connected to a laptop as the student did not understand how music was transferred from one device to the other or why certain species can survive under water but humans cannot. And lastly, students were interested in what products and objects that they saw and used in their everyday lives were comprised of. In this category, pictures of makeup, toys, and shoes were captured. As demonstrated by the collection of photographs that Francis and I received from the 19 pupils who took part in our project, science for them concerns the environment, it is a field that has led to development and progress, at the same time, science has the potential and the capacity to cause harm, it is a field that seeks to answer big questions and make sense of phenomenon, and science is involved in the production of everyday objects that are used on a daily basis.

As Skåne is undergoing a transformation to become a science region, the photographs that the youth have taken for our project can be included in the symbolic shaping process of region building. These visuals can be used as symbols of the new science region. Furthermore, the notion of a science region and the institutions that are supporting this region needs to reflect the youth's understandings of science and these pictures convey what topics and how to communicate with youth in order for interest, feelings of membership, and social consciousness to resonate and occur. The visualizations of science that has been collected from 19 pupils in Skåne contribute to region building and bring awareness to these youth of the science region that is currently being developed in hopes of identification and feelings of belonging to this region from their participation in this process.

The statement "science is everything" can be used to describe the wide range of photographs we received from the pupils, however, the collection of images are not just photographs of science. They are photographs of the students too. The photographs can be sorted into three categories. The pictures reflect the students and their futures, their thinking processes, and their background. Rather than promoting a specific vision of a science region, including how youth understand and engage with science will assist in creating a more inclusive science region, one that youth can identify with, feel a part of, and contribute to.

5.2 Displays of their Futures Plans

> Learning is not merely a matter of acquiring knowledge, it is a matter of deciding what kind of person you are and want to be and engaging in those activities that make on part of the relevant community (Brickhouse cited by France & Bay, 2010, p. 176).

From a young age, children are encouraged to dream about what their future lives will be like. When my sister was about 5-years-old, my parents asked her what she would like to be in the future and she told them she wanted to be a cashier. She wanted to be a cashier because when she was at the store, she would see the cashiers accepting people's payments and she thought that they got to keep the money that they were given for what people purchased. My younger sister's idea of wanting to be a cashier because they received money was influenced by what she saw and experienced at the stores. Similarly, what youth dream about and envision themselves doing in their careers and in their adult lives are shaped by what they have seen from examples, from what they have learnt from various sources, and from what they have had personal experience with. From "Snapshots of Science", several of the students related their photographs to their plans for the future.

Figure 1. Tina, 15, Elevator

Tina is a student in her final year of middle school and she is currently making decisions as to what program she would like to follow in high school. For a teenager at the age of 15, she was very mature and responsible. She was always prompt in replying to our e-mails to the group and was always on time. Tina was also the only participant from the group at her school that came to our scheduled group interview. Tina's father works at a restaurant in the city that she lives in and she has a young brother who is 3-years-old, which may be a reason as to why she appeared to be very responsible as she is the eldest child in her family. In our

discussion with her, Tina told us that she would like to enter the nature track in high school, which consists of studying subjects such as math, biology, and physics. Right now, Tina is interested in working in the sciences and with math. As she would like to do something related to math in the future, we asked her what she felt when working on her math homework for example. To describe what she enjoys about math, she says that "I think it's fun because when you get the solution, if it is a really hard thing, and then you finally find the solution, you feel really good, even if it was hard" (Interview with Tina, October 28, 2011). Although she has not decided what career path she would like to embark on yet, one occupation she told us she is interested in was to be an engineer. When we asked her what she thought engineers were like, she described them as being determined and as people who remembered details. Several of the photographs that Tina took reflected processes or products that involve the work of engineers.

Figure 2. Tina, 15, Construction Site

The photograph's that our participants have taken and that they have related to their possible futures demonstrates the memorable or positive experiences and engagements that these youth have had with the topic and field within the sciences. As Monica Johnson, Robert Crosnoe and Glen Elder (2011) state, "a significant portion of the meaningfulness of adolescence lies in its power to translate childhood experiences into later competencies and statuses and then, in turn, to set up the transition to adulthood" (referencing Steinberg & Morris, p. 273) Tina's educational experiences contribute to

what she thinks she is capable of doing and achieving in a future career. Engineers design and build everything from skyscrapers to bridges and tunnels to machines and in order for them to construct something that is safe, functional, and aesthetically pleasing, engineers must understand the rules of physics and solve calculations and plans through mathematics. Similarly, when asked what her perception and image of working like an engineer is like, Tina told us, "I think it's about construction and bridges […] you count on angles […] there is math" and she thinks of an engineer as "someone who is determined and remembers the details" (Interview with Tina, October 28, 2011). According to Johnson, Crosnoe and Elder (2011), within life course theory, individuals have a role in their own development where "young people select into personal experiences, interpersonal and social settings in ways that reflect their past and contribute to their futures" (p. 274). As Dawes and Larson (2011) have found in their research, when youth experienced competence in the programs and activities they were involved in, these feelings motivated them to pursue and tackle new challenges within those areas. Tina has expressed that although math may be challenging at times, she feels a great sense of accomplishment when she has solved a problem. As engineering is one of the fields she is interested in pursuing a career in someday and has already formulated an idea of what working as a engineer is like, her competency in mathematics, may confirm to her that this is a suitable and viable career option for her and thus raise her interest in engineering. Out of the 27 photographs we received from Tina, there were several images where the subject is related to engineering. In Figure 5 and Figure 6, Tina has taken a picture of a elevator, and in her set of photographs, she has also captured a construction site, architecture from the city she lives in, cars, and a laundry machine to name a few. Although she may not have been thinking about engineering specifically when she took her set of photographs for our project, a number of images stand out and reveal themselves as a field that she is interested in and perhaps will pursue in the future.

Individuals begin dreaming of their futures from a young age, however, it is their experiences and encounters that shapes and influences their dreams and future plans. Rather than encouraging youth to study in the sciences, regional planners need to recognize that the attractiveness of jobs that will be available in a science region with world-class facilities is not enough to push an individual into chemistry or physics for example. Although creating awareness as to what opportunities and resources are accessible in the science region for young people as they further their education and plan for their careers is necessary, how individuals perceive of certain fields, the experiences they have, and their feelings of competence in those fields are factors that impact whether they choose to go further in sciences or pursue other paths. Perception, experiences and competence of science varies with each young person and some youth are interested and taking steps towards pursuing dreams and careers in areas related to science, as not everyone has the same feelings however, it is

also essential for regional planners to engage with youth, who are not pursuing the sciences, and find ways in which they can connect with the science region as well.

5.3 Engaging with Science through Questioning

From my own experience with chemistry in high school, when we worked in the lab, we were instructed to test a hypothesis. Working on these assignments, we needed to answer questions as to why our results either proved the hypothesis to be correct, or why our experiment proved it to be wrong. In order for theories in science to become rules or laws, they must demonstrate that they are valid through repeated testing and questioning. The testing, observing and then the process of making sense of the results contribute to learning. During our interviews, when we asked students to describe their photos, rather than giving us explanations, some of them posed questions. As Kit Marlow Golan (2009) suggests in her thesis on the science experiences of children, "[i]f the child has no experience with [a] concept prior to the introduction through textbooks, then it is disconnected, and the student has no reality to ground their imagination in" (p. 16). A lot of work in the sciences goes towards finding solutions to questions and by asking questions, the students were demonstrating how they were thinking and demonstrating that they too are looking for answers related to science from what they see and experience in their everyday lives. The pupils in our research are all learning about science, in different ways, studying different subjects and at different levels of their education. Despite the variation in age and education, the participants communicated their questions to us based on what they have learnt and experienced so far in the field of science.

For one student in particular, science is about finding answers to everything. Charlotte is a confident and straightforward middle school student and she demonstrated through her photographs and in the interview that she was curious as to why things are the way they are and what the reasons were for things being a certain way. Currently in her last year of middle school, Charlotte is making decisions as to where she should go to high school and what track she should apply to. One point that she made very clear was that in the future, she wants to be rich. She told us how her parents would like her to be a doctor but in her opinion, she is too selfish and cares too much about herself to help other people. Although she does not want to pursue a career as a doctor, she would like to work as a scientist. When asked to define what science was, she responded with a statement that she believes can be applied to studying anything from a computer to a tree, "the questions around that object, what [it] is made of, why do you make it, what do you use it for? […] When you put these questions in a category and find the answers, we define that as science" (Interview with Charlotte, October 28, 2011). From their research, Bev France and Jacquie Bay (2010) suggest that the culture of science is one that students are unfamiliar with. Students are taught science in school, however, they do not

have the opportunity to experience the reality of what a scientist actually does and what their lives are like. One way to fill this gap between the classroom and what scientists do, France and Bay (2010) argue that "questions could be perceived as bridges between personal experience and new understandings and could provide the start of a meaningful discourse where differences between cultures could be accommodated" (referencing France & Gilbert, p. 179). Discourse in science education through the asking of questions can be viewed as "the means by which meaning is mediated and understanding [is] constructed about the physical world between cognitively and emotionally active individuals" (Osborne & Dillon referenced by France & Bay, 2010, p. 179). Rather than viewing the asking of questions as a lack of knowledge about science, questioning is the way in which a student is trying to make sense of a subject they are unfamiliar with. "A question may be the first indication of border crossing between the student's world and those of the scientist" (Aikenhead referenced by France & Bay, 2010, p. 179).

While children and youth are growing and developing, their understandings and experiences in life are continuously expanding and contribute to the broadening and deepening of their knowledge. One way in which youth learn is through asking questions. As Polycarp Ikuenobe (2001) argues, "[q]uestioning performs the functions of increasing our overall knowledge… It helps us get a deeper understanding of issues" (p. 334). When a student asks a question, they are searching for knowledge and information. When they are asked, questions are formulated based on the young person's assumptions, their backgrounds, their beliefs, and information that they have been exposed to (Ikuenobe, 2001). Furthermore, "the notion of questioning has a psychological correlative, which is the expectation that an answer should provide some information and satisfaction. This derives from the idea that an answer must satisfy [one's] curiosity and make sense, in that [individuals can] believe it is likely to be true based on its evidential relations to [their] background beliefs, meta-beliefs and conceptual scheme" (Ikuenobe, 2001,p. 332). In order for students to learn through questioning, answers that they are given must also resonate and make sense to them once the answer has been filtered through their habitus and the understandings they have developed and the knowledge that they have already acquired.

Aside from searching for new knowledge, asking questions may also be a demonstration of critical thinking. In their research, Hasan Seker and Sevki Kömür (2008) references Halonen who has pointed out that "an information society requires the equipment of critical competence. The development of thinking skills will equip future generations to generate new ideas, and give them the basis to provide reasoning for, and explanations of, events taking place in daily life" (p. 390). Critical thinking "is an attitude of being disposed to consider in a thoughtful, perceptive manner the problems and subjects that come within the range of one's experience" (Seker & Kömür, 2008, p.

391). There are two fundamental types and functions of questioning according to Ikuenobe (2001). Students ask questions to find answers and gain information, and the second function is to stir up critical analysis. As Ikuenobe (2001) suggests, questioning allows individuals to "explore issues about the initial information provided, to determine its adequacy. This secondary function of questioning includes…challenging and criticizing in a positive and constructive way, to help people explore their ideas" (p. 334). When students are presented with something new for the first time, they must engage in critical thinking and decipher this new information through what they already know and have experienced to be true and right. Critical thinking allows youth to see from new perspectives, to challenge what they have learnt, and to formulate their own opinions and beliefs. It is through interactions with different people, different situations, and different understandings where youth are able to interpret, think through, and make sense of their own world (Seker & Kömür, 2008).

Figure 3. Charlotte, 14, Light

The questions that students asked were connected to what they experienced in their everyday lives. Rather than asking specific questions regarding the mixing of chemicals for example, they were fascinated by what they observed in their surroundings. In Figure 3, although it may look like a picture of a corner of her house, Charlotte was interested in the light that appears in the photograph.

Regarding this image, Charlotte asked, “How does light spread?”, “Why does it reflect on glass?”, “Why does it reflect on objects with certain shapes and made of certain substances?” (Interview with Charlotte, October 28, 2011). Charlotte was asking questions regarding light, something that we are all familiar with. There is natural light provided through the sun, artificial lighting has been created through light bulbs and, and light is necessary in order for people to see clearly. The intricate details, the rules and the laws, the science behind lighting however, is something that Charlotte and the younger generation in particular, does not know about at a deeper level. This photograph of the light reflecting off of the window is just one of 27 photographs that Charlotte took, and the questions she posed for each picture are similar and start with “why?”. Questioning why, what and how things are demonstrates that Charlotte is curious and that curiosity may lead to taking actions towards learning and understanding what she does not yet have the answers to.

Similar questions as to why things are the ways they are, were asked by a student in a science based high school named Anna. For this teenager, science is seen in everyday life. She views science as creation, as a process and her photographs centers around objects that she uses in her day-to-day life. What intrigues Anna about science is that it is a process of uncovering how things came to be. The notion that science is creation and science is a process can also be reflected in Anna’s interests. When asked what hobbies this group of participants took part in, Anna told us that she liked scrapbooking. Scrapbooking is a way of remembering personal and family histories through using

Figure 4. Anna, 16, Make-up

photographs, memorabilia, and using different types of art and craft materials complimented with writing to decorate pages detailing memories. From personal experience, scrapbooking requires time and the completed page has many different layers and details that lead up to the final product. Similarly, conducting a science experiment in school requires many steps and often times, science requires people to take certain actions in order to achieve their desired results and outcomes. For Anna, the makeup pictured in Figure 4 is the final product, what interests her is what material are in the makeup, why they are used in its production, and how these ingredients are transformed to become something that she can use on her skin every day.

The photographs are not just images of what students identify as science rather they are visualizations of things, objects, and phenomena that the pupils are intrigued over and would like to further understand. The research that is being conducted in labs, the way medical doctors can diagnose patients, and what engineers need to know before embarking on a new project all start with asking questions. Questions lead to answers and although the questions that were posed by the pupils in our project may not have been answered yet, the curiosity they demonstrate is the first step towards learning and discovering.

The institutions within the region, whether they are universities, neutron blasting facilities such as ESS MAX IV, and businesses and laboratories in Skåne have the ability to answer the questions that youth are asking in regards to science. Its physical borders may demarcate a region however, in order for a region to thrive and to perpetuate the symbolic notion of the region, individuals in society need to actively take part in it to sustain it. Encouraging children and youth to think from different perspectives, ask big questions, and to challenge what they know about science engages them and brings them into communication and participation in perpetuating the region. Rather than focusing pupils and youth's attention only to material sciences or ESS MAX IV, encouraging young people to explore a wide range of questions and topics will allow them to feel as if what they are concerned with and curious about in science are also important and heard, and perhaps spark new interests.

5.4 Habitus and Photographs as a Reflection of the Student

Figure 5. Mark, 16, Apple Tree

When students have grasped specific scientific concepts and processes, this understanding will affect their personal lives in the decisions they make and the beliefs and values that they hold and act accordingly. At the same time, the life experiences students have accumulated at home with their family, at school through their education, and from their extra-curricular activities, influences their experiences and understandings of science. Individuals are embodiments of their upbringing, culture, knowledge and previous experiences, and how people see the world and make sense of it is influenced by this notion of habitus. When the students were capturing photographs of science, they were capturing where they could identify what they understood and recognized as science from their own everyday lives. Not only were the youth taking photographs through a camera lens, they were taking photographs that were filtered by their habitus and funds of knowledge, and through their photos, they were displaying themselves and their grasp of science.

A concrete example of how a student's photographs are a reflection of who they are and how they have been shaped by their upbringing, culture, and experiences can be illustrated by one of the participant's, Mark. Mark is in his first year of high school and lives in a town that is also home to a large corporation specializing in the chemical sector. The high school that he attends is small and has its focus on chemistry and the sciences. As a hobby, Mark has been

Figure 6. Mark, 16, Greenhouse

training in karate for the last 7 to 8 years and is about to receive a black belt. He expressed that he would like to stay in Sweden for university however he told us that he did not want to stay in Skåne after completing his education. Although his friends and classmates who participated in the project all mentioned places they would like to go to live and work, Mark did not give us any suggestions nor did he have any ideas yet as to where he would like to go. From several of the photographs he took and what he spoke about in the follow-up interview, it was apparent that his thoughts and interests in science were shaped by the practices of his family. In his series of photographs, Mark had captured a photograph of an apple tree and a photograph of a greenhouse (Figure 5 and 6). When asked why he took the picture of the apple tree, Mark discussed how in our world today, we use many different chemicals to conserve or to preserve food even though we can consume food that is fresh. When he was asked about his photograph of the greenhouse with an atlas in front of it, Mark explained how global warming was affecting the planet and he tried to provide a visual of the world through a map on the atlas. Furthermore, he mentioned how the use of green energy may lead to less pollution. Although the explanation Mark gave us regarding the greenhouse was not directly related to the apple tree and eating fresh and natural food, when asked where the greenhouse was and what was inside of it, he told us that it was his family's greenhouse and that it was used to grow their own vegetables. The subject of many of Mark's photographs was related to the environment and it was an

issue that he was concerned about and wanted to communicate to us. In another of his photographs, he parked his bicycle next to their family's Volvo station wagon and asked why people needed to drive the car when they are going close distances like to the grocery store to shop for a few items, when they could take their bicycle. At the same time, from the photographs he gave us and from the interview, it became clear to us that his concern for the environment was shaped by his family life and his upbringing even though he may not have been aware of it.

Many societies around the world today are aware of and taking actions towards countering global warming, corporations have branded their products as being environmentally friendly and organic, and natural disasters around the world have attracted people's attention to thinking about and being more concerned about how societies actions has real effects on the world. The environment is a popular topic in society today, and although Mark may be made aware of these issues in Swedish society and around the world today through the media or through what he encounters in his everyday life, it is his practices that reveal not only his knowledge, but who he is as well. It is through the practices of an individual as well as their actions and dispositions that demonstrate one's habitus and provides an indication as to how a person is culturally constructed and developed (Basu & Barton, 2007). Through his photographs and what he discussed in the interview, Mark demonstrates that his photographs were both a reflection of his knowledge and how his concern for a specific area of science, the environment, has been shaped by his habitus, and thus his images are a reflection of who he is.

Although it may not always be visible from an individual's outward appearance, people can be viewed as embodiments of their entire lives and the experiences they have accumulated. According to the American National Research Council and their National Science Education Standards, scientific literacy is "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs and economic productivity" (cited by Muslu & Macaroglu Akgül, 2006, p. 226). Furthering this understanding, the Royal Society in the United Kingdom delves deeper and states that "dimensions of scientific literacy include: (a) Science content: understanding facts, laws, concepts and theories. (b) Scientific inquiry: understanding of the scientific approach to inquiry and the ability to define scientific study and discriminate between science and non-science. (c) Social enterprise: understanding science as a social enterprise" (cited by Muslu & Akgül, 2006, p. 226). In order to capture photographs, students had to have some knowledge regarding the subject and topic of their images, as they were aware that that they would need to describe and explain why they had chosen to capture what they did. In our case, scientific literacy, or what the pupils comprehend about science was communicated.

The photographs that the pupils have captured as science are a reflection of who they are and what they have learnt and experienced as science. Youth may recognize that they are living in the region when they interact with symbols and institutions that they come into contact with and are aware of in their everyday lives, such as going to school, visiting the doctor's office, or using public transportation for example. In order for children and young people to recognize and grasp the science region in which planners are working towards creating, planners need to create associations between their vision and notion of science, with the scientific literacy youth have accumulated through their upbringing and habitus, as well as through what they have learnt from their lifetime of experiences.

The word science is complex and may be interpreted differently depending on who one is speaking to. For youth today, science is a subject that is taught in school, science is something that is discussed in the news, there is a whole genre of fiction devoted to science-fiction, and science can be experienced in the form of a visit to the doctor and going to the pharmacy to name a few examples. Science is also credited and recognized as the basis of many aspects of everyday life and what is being experienced and utilized in society. The 19 pupils who contributed photographs to the project demonstrate a few of the many associations that young people make with science. Science is represented as concern for the environment, it is represented as a field in which a future career may be possible, and science is represented as a way to discovering the answers to questions.

Chapter 6: Conclusions

6.1 Summary and Discussion

The slogan heading into the next few years for Region Skåne, particularly with the construction and operation of ESS MAX IV, is "Society for Science – Science for Society" (Region Skåne, 2009, p. 5). This thesis was inspired by and draws upon data that I collected along with my colleague Raakesha Francis for Region Skåne, who are trying to understand how youth perceive of science and how to promote the educational and career opportunities that will be available to this group through ESS MAX IV and its spin-off effects on the region. The region of Skåne has already established itself territorially, institutionally, and symbolically. However, a transformation is occurring as the region is planning and working towards establishing itself with a new identity and a new brand, the region is reconstructing itself as a science region. The children and youth living in Skåne today will be the group who will grow up in this developing science region and have the opportunity to work in and participate in ESS MAX IV in the coming years. This group of young people may be viewed and categorized by those in government as the future science generation, individuals who have been brought up and surrounded by a society influenced by science.

As regions are social constructs, it is necessary for Region Skåne to create feelings of belonging, encourage participation to foster a sense of inclusion, and to generate the desire in youth to participate in the building and maintenance of this science region. The photographs that the 19 student participants captured for the project "Snapshots of Science" reveal that the field of science is complex. Every individual has different definitions, ideas, and associations with science, however, there is similarity in what and how youth think about science as demonstrated by their visualizations. Youth's understanding of science is shaped by their background, they are influenced by what they learn in their everyday lives, and their interactions and experiences impacts what and how they think about science. The images convey what the youth are contemplating as possibilities in their futures, they displayed the inquiries that students are interested in uncovering the answers to, and lastly, the pictures are visualizations of the individual students who embody their upbringing, values, and grasp of science. Furthermore, these photographs captured by the pupils, which have now been viewed by politicians and planners at Region Skåne, as well as having traveled to different institutions in the region, are also valuable as they are the youth's contribution to the resource of symbols and signs the government can draw upon to represent aspects of the science region they are building.

In some regards, it is apparent that there is a community beginning to form and in order for a science region to proliferate, collaboration between all groups in society needs to occur. The facilities ESS MAX IV is co-hosted and funded by a number of European countries, and it is

expected that researchers from around the world will come to work at these institutions in Skåne. A scientific community already exists in the region through the universities, science and innovation parks, and this community will only grow when ESS MAX IV begins to operate. Outside of this scientific community however, there are groups in society that need to realize that they too are a part of this greater science region. Through the project "Snapshots of Science" and having young people take part as co-researchers, Region Skåne is recognizing the need for children and youth to participate in the science region that is being developed. In order for individuals to feel as if they belong and to identify with the science region that they are living in, the experiences and knowledge of science that people have needs to be reflected in the symbols, the values, and the narratives communicated by the region. It is through collaboration that not only will a science community be able to sustain itself, but for a science region to progress as well.

6.2 Where Do We Go From Here?

Region building is a continuous process, a region is always being constructed and it constantly needs to be maintained. One question that comes to my mind now as I conclude this thesis is, "what do we do with these photographs?". For planners and politicians, these photographs are a resource that they can draw upon as they continue working towards transforming Skåne into a science region.

First, through using photography as a research method, the student participants became co-researchers in the project, and they were given a medium through which to communicate their thoughts and perceptions on the topic of science. At the exhibition on December 1st, one of our participants told us she was excited and proud that she had been quoted by one of the politicians in one of the short speeches at the exhibition as one of her quotes had been featured on the gallery wall that evening. In order to understand young people and to include them in the region building process, those at Region Skåne need to meet with children and youth and interact with them, acknowledging that this group of young people are social actors who need to be consulted on how the region they are living in develops and have the capacity to contribute to this process. When they are consulted, the participants in our project demonstrated commitment and as they knew their photographs would be seen by politicians, they could recognize the importance of what they were doing and felt a sense of pride for being involved in it. Including young people in the development of the region fosters a sense of ownership and belonging in this group, as they will be the ones who will be living in and perpetuating the science region for many years to come.

Secondly, connections need to be made between the projected science region, and what youth actually know and understand as science. In order for engagement and identification to occur, people need to be able to relate to and grasp the essence of the region. As mentioned earlier, Region Skåne

is interested in material science, as that is where a significant part of research at ESS MAX IV will be focused on. Rather than trying to connect children and youth with a field of science they are not familiar with, planners need to demonstrate how the work that will be done at ESS MAX IV has impacts on the everyday lives and experiences of this group of young people. The topics youth are interested in, are concerned about, and have knowledge of are displayed in the photographs collected in "Snapshots of Science". These are photographs of ways in which to connect with and engage youth in this science region.

Thirdly, it is necessary for the region to keep in mind that the experiences people have influences their perception and participation with the field of science. Positive experiences with science may stimulate children and youth to pursue higher education and a career in this vast field however, this may not occur with all youth. A science region encompasses all of society, and although not everyone may share the same enthusiasm for science, it is important that everyone is included in it. On an individual level, the region is able to connect and communicate what the research being conducted is and how it may impact the everyday lives and the concerns of its citizens. On a more public level, the region has the ability to host events and create spaces for youth and adults to interact with science and the research being done in Skåne for example, so that they continue to have experiences and encounters with science.

Collaboration, experiences, and interaction with youth are aspects of region building that planners and politicians need to have in mind as they work towards constructing a science region. A science region is not constructed or built in a day and a science region will not exist without individuals in society identifying with this notion and perpetuating it. As Region Skåne moves forward with their plans to transform Skåne into a science region, through understanding youth's visualizations of science and incorporating them in its development, the notion of a science region may become a lived reality for children and youth growing up in Skåne.

Chapter 7: References

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