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CHOOSING SCIENCE:
The Role Of Social Values

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Abstract

In this work, the researcher investigated whether social values have a role in students' decisions to study the natural sciences. The research employed ethnography which included interactive discussions on some Relevance Of Science Education(ROSE) slides and focus group interviews as data collecting instruments.

The research was done within the joint framework of the Theory of Reasoned Action and the Goal Theory. Collected data from the entire study indicate conformity with both theories to a large extent.

Findings reveal that social values play both motivational and attitudinal roles in the students' choices of the natural sciences at higher secondary school level. Social values inform reasons for some students' attachment to the natural sciences as well as other students' disenchantment with those subjects. Taken together, the findings suggest that social values may help explain present levels of take-up of natural science as career.

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Table of Contents

Table of Contents

Chapter 1

INTRODUCTION

1.1 Introduction

In a fast advancing and changing technological world, science has become the backbone of development,… (Avotri,Owusu-darko, Eghan,& Ocansey,2000: 36).

This work on *Choosing Science* is going to be done from two perspectives: personal experience of the researcher as a former science and technology teacher in Sierra Leone and Bangladesh and the reality of science and technology education in the context of Sweden. Otherwise stated, the study will be done from the developing world and the developed world perspectives. It stems from the fact that young people in many parts of the world have been reluctant to participate in science education and reluctance seems to be on the increase. Such phenomenon prompts the question: *Why do students choose not to study the sciences in the upper secondary school and post upper secondary school levels?* As is already evident, this is a broad question that might encapsulate a lot of factors which in turn might raise a cluster of questions relating to the problem at hand. Some of the subsidiary questions are: *a) Does tradition or culture play a role in students' subject choices? b) What are the values of the society in which the students live? c) How do students' opinions about compulsory school science influence their subject choices for upper secondary school? d) Are young people not motivated enough? If so, what are the factors responsible?* As we have seen, there are already numerous questions in the cluster whose answers though cannot be underrated will be unsuitable as the focus of the study.

Recounting past personal experiences as a science and technology teacher in two developing countries revealed that most students in high school are not interested in the natural sciences due to reasons best known to them, their teachers or their parents and the reasons can be a combination of different factors. Among these students were those who found it interesting or exciting to attend laboratory sessions only because of attractive demonstrations or performances of experiments by teachers as well as students. With underpinnings from relevant publications this is not only a problem for developing countries but developed countries as well. The existing paradox is that in spite of the primacy of science and technology education in developed countries (which are the focii of this study), many young people tend to lose interest in these domains in schools and further studies (Schreiner and Sjøberg, 2004).

Now this loss of interest is a cause for concern especially in highly industrialized developed countries. According to Sjøberg(2000) pupils in developing countries have far more positive images of scientists and their potential for helping people than pupils in developed countries. Based on such information, it is clear that the problem and its causes have impacts or effects on different places and times. As most literature sources indicate, most research in science and technology education has been dominated by the cognitive sides of teaching and learning which indicates a monotonous and one-sided focus. In my candid opinion, it is about time attention is directed to the importance of examining the motivational and attitudinal aspects of teaching and learning and the problems associated with them especially outside the classroom.

So what is this curiosity about students learning or not learning science? Doctors, nurses, scientists, engineers and other science-related professionals play major and important roles in the development and progress of a country on a daily basis. And to qualify or acquire the competencies of a science-related professional a sound background in the natural sciences is required. Furthermore, to face the

challenges of globalization, new technologies and competitive knowledge-based industries, a high quality science and technology education should be given priority. Consequently, slogans like ¨Science for all¨, ¨Scientific and technological literacy¨ and ¨Public understanding of science¨are taking the limelight in educational and public debates. Science and technology in most countries are embroiled in problems as indicated by educational research, opinion polls, surveys as well as educational statistics for choices and recruitment (Schreiner and Sjøberg, 2004). Among these problems are a lack of interest in science and technology, at least as school subjects and tertiary studies and a meagre understanding of the methods and contents as well as their role in society and culture. According to Drury&Allen(2002) and Jørgensen(1998), the inadequacy in the number of young people pursuing scientific and technological careers to secure the future needs for scientific and technological competencies in most western countries is of great concern.

It is clear and unambiguous if the status quo is maintained in such a dynamic world, for the next twenty years, industries will find it problematic to meet production targets due to scarcity of qualified personnel. The world economy might slowdown since most developing countries depend on products and services from the developed world and failure to address this problem will give rise to serious implications.

The objective of the proposed study is not only to find out factors responsible for students' disengagement from the sciences but also those responsible for their motivation as well as instilling positive learning attitudes towards the natural sciences with a special focus on social values. The emphasis will be on students who have studied the natural sciences at the lower secondary school and have made informed subject choices which are a requirement for entry into the upper secondary school level as well as students already in the upper secondary school. For the information of readers, this proposed research is not geared towards any path-breaking outcomes as there has been a lot of studies on students' decision to study or not study certain subjects but if by chance any happens to emerge it will be a welcome breakthrough or achievement which can help provide a solution to a long-standing conundrum present in education systems worldwide. As aforementioned, it is a fact that previous work has been done on students' motivation in the study of the natural sciences and this study which has not deviated from the problem at hand will be a useful contribution to the existing knowledge in this domain. The outcomes are also expected to underpin outcomes of previous studies undertaken by well-known scholars. This work will include a comprehensive literature review and report on attitudes towards science via focus group interviews and interactive discussions to investigate motivation for choosing or not choosing to study science.

1.1.1 Explanation of key terms

To put this study and its stated objective into perspective, the meanings OF social values, attitudes and motivation in connection with this study will be explained and a relation will be established between them.
As outlined in 1.1 the focus of this work are social values with emphasis on attitudinal and motivational aspects. Though this work is mainly about students choosing or not choosing to study the natural sciences at higher secondary level, the sociological impact of values, a powerful societal driving force, cannot be sidelined which therefore makes shedding some light necessary. This section will highlight holistically the different sorts of values, what they stand for and specifically the prominence and origin of social values. The section will also try to describe attitudes and motivation as well as highlight their significance to individuals especially young learners who are on the verge of making informed subject choices at secondary school level.

1.1.1.1 Social Values

In generic terms, values are different, lasting and important beliefs or ideals shared by people that belong to a particular culture. Values are things that we hold in high esteem.
Values are basically about what is good or bad and what is desirable or undesirable. They have a major influence on the behaviours or attitudes of individuals and can serve as a broad guideline in every situation. According to H.M. Johnson(1998), a renowned sociologist, values are general standards and may be regarded as higher order norms. Also according to Michael Haralambos(2004), another renowned sociologist, values are beliefs that something is good and worthwhile. They define what is worth having and worth striving for. Now these two definitions underline the importance of values and confirm the preceding definitions. But that is not all as there are numerous opinions on values as can be seen in further paragraphs of this section.

Values play a vital role in ethical decision-making (https://www.andrew.cmu.edu/course/80-241/guided_inquiries/vcr_html/2100.html).Inspite of varations in
ethics literature about the constituents of values, the fact remains they are items of worth.
People attach values to different things which can be in the form of cars, love, education, prestige status, money, careers etc. In the same vein people find it worthy of pursuing what they only value and value what they find as worthy of being pursued. In a nutshell, values make the fundamental factors in the motivation of human behaviour (https://www.andrew.cmu.edu/course/80-241/guided_inquiries/vcr_html/2100.html).

Values are of different types and depend on the kind of influence they exert on the person or the motivating power they possess (https://www.andrew.cmu.edu/course/80-241/guided_inquiries/vcr_html/2100.html). Definitive values are also called core values which are the basic values a person might be willing to die for. Nobody will want to sacrifice or abandon his or her core values. Core values are subjective and can be relative to the individuals and vary from person to person. Shared values are those that enable agreement and harmony to supersede conflict.These values are usually held by families, groups, societies, associations and nations and provide the basis upon which these entities are formed. Since shared values are the backbone or cohesive element in the aforementioned collectives, they can also be called social values. Social values are an important segment of the society's culture. The stability of social order is accounted for by its values which provide the general guidelines for social conduct. Democracy, fundamental rights, equality, prestige, status, sacrifice, education, individualism etc. guide people's behaviour in several ways.

Finally, values are vital tools in a smooth-functioning society in that they serve as the criteria used by people in assessing their daily lives. They also help people set their priorities as well as choose between alternative courses of action. These choices can be motivational or attitudinal as described in 3.1 and 3.2 by the Theory of Reasoned Action (TRA) and the Goal Theory(GT) which have been chosen as the theoretical frameworks for this study.

1.1.1.2 Attitudes

An attitude, as defined by Hogg and Vaughan(2005), is a relatively enduring organisation of beliefs, feelings and behavioural tendencies towards socially significant objects, groups, events or symbols. Eagley and Chaiken(1993) also define an attitude as a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour. No matter how one looks at it, an attitude is a social orientation. It has a primary disposition to respond to something either positively or negatively.
The structure of an attitude can be described in terms of three components.These three components make up the model known as the ABC model of attitudes.
i) The Affective component:-This refers to a person's feelings or emotions about the attitude object.

ii) The Behavioural or Conative component:- This refers to the way a person's attitude influences his or her actions or behaviour.
iii) The Cognitive component:-This refers to a person's beliefs or knowledge about an attitude object.

There is an underlying assumption about the link between attitudes and behaviour which is that of consistency. From such assumption, it means that a person's behaviour is expected to be consistent with with that person's attitude. This is known as the principle of consistency.
The principle of consistency manifests the idea that all human beings are rational and therefore seemingly attempt to behave so at all times. Furthermore, a person's behaviour should be consistent with his or her attitudes. Though the principle might be a good one, it has been found out that because sometimes people behave in illogical ways, they therefore do not always follow it (the principle). A study by La Piere(1934) provided evidence that the cognitive and affective components of behaviour are not always compatible with their behaviours. This finding by La Piere is expected to have a significant implication on the expected findings from this study.

1.1.1.4 Motivation

Motivation can be referred to as that which gives direction to a behaviour. Motivation is also the process that initiates, guides, and maintains goal-oriented behaviors. It involves emotional, biological cognitive and social forces that activate behavior. The study of motivation seeks to address questions regarding the reasons for which people initiate, terminate, or persist in specific actions. In the field of psychology, motivation has being distinguished into two types namely, intrinsic and extrinsic. According to Otis, Grouzet and Pelletier (2005), intrinsic motivation deals with engaging in activities for inherent reasons. When a person is intrinsically motivated he or she will perform an activity out of the satisfaction that can be derived while doing it. On the other hand Otis et al(2005) have also defined extrinsic motivation as engaging in activities for instrumental reasons that may include consequential rewards or punishments emanating from the behaviour. In such case the individual's reason for participation in an activity is separate from the activity.

Like attitudes, motivation has three main components. These components are activation, persistence and intensity.
i) The Activation component:- This involves the decision to initiate a behaviour.
ii) The Persistence component:- This has to do with the continued effort towards a goal inspite of the existence of obstacles.
Iii) The Intensity component:- This can be seen in the concentration and vigour employed in pursuing a goal.
So what makes people behave the way they do? Psychologists have proposed a number of theories to explain human behaviours. According to Nevid (2013) the following three theories are prominent:
i)The Instincts theory:- This theory suggests that behaviors are motivated by instincts. An instinct is a fixed and inborn pattern of behavior. Psychologists including William James, Sigmund Freud and William McDougal have proposed a number of basic human instincts that motivate behavior. Such instincts might include biological instincts that are important for an organism's survival such as fear, cleanliness and love.
ii)The Drives and Needs theory:- Drive theory suggests that people have basic biological drives and that our behaviors are motivated by the need to fulfill these drives. We have a biological need for food, water and sleep, therefore we are motivated to eat, drink and sleep.
Probably the most well-known needs theory was proposed by Abraham Maslow (1954).
Maslow(1954,1970) contended that most motivation theories had serious shortcomings as they only

dealt with basic physiological needs like hunger, thirst and avoiding anxiety. The theories however omit in general the important needs pertaining to personal growth. Maslow therefore decided to address such issue by postulating a hierarchy of needs. In a nutshell Maslow's hierarchy of needs entails:

- Self-actualization Needs:- The need to realize one's full potential.
- Esteem Needs:- The need to be valued by one's self and others as valuable contributor.
- Belongingness Needs:- The need to be part of a larger group, to be accepted and liked by others.
- Security Needs:- The need to feel safe and secure. The need for a stable learning environment.
- Physiological Needs:- Basic needs for sustenance and shelter.

Maslow considered all needs at the bottom as defficiency needs while those towards the top as growth needs. Though the needs are hierarchical, Maslow accepted that satisfaction of the needs is not always from bottom to top since individuals and circumstances may differ.

iii)The Arousal theory:- The arousal theory suggests that people are motivated to engage in behaviors that help them maintain their optimal level of arousal. A person with low arousal needs might pursue relaxing activities while those with high arousal needs might be motivated to engage in exciting, thrill-seeking behaviors.
From this information on motivation the question that may arise is whether students will be driven by intrinsic motivation or extrinsic motivation or both in their choice of the natural sciences at higher secondary school level, a stage in which the consciousness to self-actualization has gradually begun.

The explanation of these key terms can somehow reflect the link between values and attitudes as well as that between values and motivation. Simply put, social values can instil a positive attitude in a student towards the natural sciences which can in turn induce the required behaviour in that student to study those subjects at higher secondary school level. Social values can be a very strong motivating force for students to study the natural sciences.
This researcher can also contend that choosing to study the natural sciences in a society that values science-related professions is an ethical decision in that it is considered by the society's constituents as the right thing to do. But the questions remain: will the data in this work be prone to these values or will they suggest otherwise? Will the data reflect the three theories of motivation discussed above? Will the behaviour of the subjects of this study be influenced by their attitudes? Will the subjects have positive attitudes towards the natural sciences?

1.2 Research questions

Research indicates that students in developed societies are not as interested in the physical or natural sciences as their counterparts in the developing countries raising a lot of concerns. Their reasons according to some findings range from school settings to influences from the societies in which they live. Inspite of huge investments in science and technology education by developed societies, the population of high school students opting for the sciences keeps dwindling in what seems to be a total disenchantment with the science domain. According to ROSE (Relevance Of Science Education) the more developed the country the less interested are the youths in science. Though alarming it indicates a kind of complacency in young learners. To date there is no convincing explanation on why such phenomenon occurs. To shed light on this problem the following two research questions are addressed:

1) What are the social values that prompt secondary school students to opt for studying the natural sciences?
2) What is the role of social values in secondary school students' opting to study the natural sciences?

1.3 Significance of the problem

In the U.K. the proportion of students studying physics at A-level dwindled from 6.6% to 3.4% between 1990 and 2008. The proportion studying chemistry also witnessed a fall from 6.8% to 5 % (Bø, Henriksen, Lyons & Schreiner, 2011). Proportionally fewer students have been choosing science at an initial decision stage. Between 1992 and 2007, the proportions of higher secondary school students studying physics, biology and chemistry saw decline of 26%, 22% and 29%(Bøe et al. ,2011).

In France the percentage of senior secondary school graduates enrolling for science courses, excluding health and medicine, in their first year at the university decreased from 8.4% in 1995 to half (i.e.4.3%) in 2007. Japan has also been concerned about the 'flight from science' in that the number of students studying science and engineering decreased by 10% between 1999 and 2007(Bøe et al., 2011). In many countries students' disengagement from science has been more present during the transition from lower to higher secondary school or from higher secondary school to the university.

Studies have shown that there is clear-cut evidence youths in many countries tend to make different choices about participation in science courses. For instance in 2006, according to a PISA study, 15-year-old boys are more inclined to future science-related study and careers than their female counterparts in countries like Japan, Korea, the Netherlands, Germany, Iceland and Taiwan. And conversely, results from Sweden, Denmark, Australia, New Zealand and Canada show no significant difference (Bøe et al.,2011).

The foregoing paragraphs have outlined why the science choice is a cause for concern. But that is just the tip of the iceberg as there is more to the problem than meets the eye. To reinforce some of the claims made in section 1, I will present below why according to Bø et al. (2011) students should choose the sciences at higher secondary school and post-secondary school:

"The society needs more people in science-related professions in order to meet future and current demands. For example, to secure a sustainable and adequate energy supply.

Science needs a greater mix of professionals in order to develop in new ways. A greater diversity of perspectives, experiences and work forms may increase the innovative potential and push science forward helping to adapt to changing societies.
Women and other under-represented groups need science in order to be empowered to influence their own lives and the world's development"(p5).

The above information has been provided to highlight the severity and the universality of the problems posed by the declination of science students' population over the years. The reluctance of students to study science is one that cannot be attributed to just one factor but a myriad of them. Chapter 2 will delve on attitudes and motivation as possible factors for students' choices on which terrains my proposed study will also tread but in a different direction. My study which will focus on social values will not only contribute to the existing ones in this area but also buttress or underpin existing findings. As had already been stated, the study is going to be done from different perspectives and findings are expected to reveal information that will be valuable to schools, governments and non-government organizations. The findings to some extent may contribute towards the improvement of science education in many countries in that significant factors will be unearthed which might help authorities

in restructuring their policies and sensitize their societies so as to boost students' participation in studying the natural sciences.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

Choosing to study the natural sciences at secondary school level has been a nagging problem for most educational systems in both developing and developed countries resulting in serious implications. Studies have shown that as societies become technologically-dependent, the need for scientific literacy increases which calls for the recognition of the importance of science and mathematics education in daily life. Though scienctific literacy has been discovered to be a neccessity yet still many students do not seem interested in any courses that have to do with the natural sciences or in the worst case one that has to do with calculations. This is a trend that has been continuing with the number of students constantly dwindling in most developed countries especially in the middle-grade levels at secondary school where according to Eccles & Midgley(1989); Palincsar, Anderson, & David(1993); Simpson& Oliver(1985), motivation towards science tends to decline. Eccles(1984) and Wheelock & Dorman(1988) noted that such changes in science motivation maybe evident for girls and students with academic difficulties in particular.

It is a fact that schools in most developed countries crave for students who are interested in studying the sciences and who continue to participate in science classes throughout high school and post-high school education. Unfortunately research evidence indicates a decline in achievement motivation after students move to middle-level schools (Eccles et al., 1993; Marsh, 1989; Midgley, Feldlaufer, & Eccles, 1989;Stipek, 1984).

Evidence of marked decline in intrinsic motivation and attitude towards science is food for thought (Gottfried, 1985; Haladyna & Shaughnessy, 1982; Haladyna &Thomas, 1979; Simpson & Oliver, 1985, 1990; Simpson & Troost, 1982) as well as the stronger effects stressed by the goals in the school and the bearing they have on students' motivation during the middle school years(Maehr, 1991).A wide range of factors may contribute to such decline, including an increase in ability-focused instructional practices and the tendency to use less varied forms of assessment to evaluate student progress at the middle level (Eccles & Midgley, 1989; Gullickson, 1985). Of particular focus are the possible weakening effects of ability-focused instructional practices on new instructional methods aimed at increasing student motivation toward science.
According to data obtained from numerous surveys carried out by the relevance of science education (ROSE) group situated in Norway, there is a continually widening gap between high school students in the developed societies and the natural sciences taught in schools whereas the reverse is true for the developing world.

This literature review seeks to find reasons for students' lack of interest in the sciences culminating in a disinclination to include them in their choices for study in the advanced stages of high school. In the same vein also the review will examine the other group of students whose attraction to science has led

them to prioritize the concerned subjects in their study choices for high school. The role of social values is the focus of this research. To achieve the outlined objective, this literature review will draw from research conducted on motivation and attitudes with special focus on studying sciences or science-related courses by high school students mainly in the developed or industrialized world.

2.2 Review of the literature

Munro and Ellson (2000) studied how teachers and career advisers influence the students' decisions about choosing science subjects at the age of sixteen. In their findings they highlighted that students enjoyed science up to year nine in the schools they investigated though a few regretted having studied it.They also figured out that those students who had plans to drop science later in high school made up their minds towards the end of year depending on their previous experience of classroom science. They observed that students who plan to continue with science do so out of interest or career motives. Their findings project students as people who need strong and valid reasons to study science which agrees with what is proposed in the Goal Theory and the Theory of Reasoned Action.

Hipkins and Bolstad (2005) in disagreement with Munro and Ellson contended that a great deal is still unknown about students' decision-making in relation to studying science.They cited contextual factors like family background as having a visible impact on students' decisions. They also asserted that there is no particular way to account for students' choice patterns. Moreover, they pointed out that students have different reasons and circumstances coupled with their dispositions, interest future plans and choice-making patterns which echoes part of Munro and Ellson's findings.
But the contention that a great deal remaining still undiscovered concerning decisions about studying science may be tenable in 2005 or in preceding years since most of the findings of studies postdating 2005 have suggested otherwise. Infact a great deal has been unearthed as will be seen further in this review.

According to Lyons and Quinn (2010), the dwindling proportions of students studying science is nothing new, strange or surprising but a part of a broader phenomenon that has been replicated in many traditional subject areas. The declination or dwindling was attributed most likely to an interrelated set of factors centring on the changing contexts of subject choice for senior high school.They contended that the principal factor is apparently the students' responses to the greater array of choices available in year 11, culminating in proportionally poor enrollments in many traditional subjects. They opined that the context of greater options has increased the influence of three contributing factors closely linked with science education. These contributing factors include students' difficulty in projecting themselves as scientists; the inability of school science to appeal to a wider range of students and the utility of the natural sciences' incompatibilty with the levels of difficulty. Consequently the utility keeps decreasing while their difficulty either remains constant or heightens. The findings appear to be significant because they have highlighted three prominent factors which are common contributors to students' disengagement with science as well as dampen students' motivation.Teachers and students participated in the survey and happen to share similar views which adds weight to the findings.

In another study, Taconis and Kassels (2009) discovered choosing science depends on the student's individual suitability to the science culture. In their findings,they articulated that students make their choices with influence from the behaviour and appearance of people involved with science such as teachers and scientists who they sometimes see as role models.
The findings also intimated that students shared the belief that people who are engaged in science possess certain culture as well as specific personality traits. Though the students perceived scientists as lagging in popularity, attractiveness, social competence, creativity and emotions, they still see them as more intelligent and highly motivated than their counterparts in the humanities. These findings seem

to be in agreement to some extent with those of Topinka et al.

Böe et al. (2011) obtained evidence about young people's interest in school science and mathematics.The evidence showed that the interest in school science and mathematics was steadily declining and that there was no room for improvement as the youths move from a lower stage to a higher stage in high school.It was a kind of inverse relationship in that the higher they go in high school, the lower their interests. The researchers also discovered a characterisation of science and mathematics in the contexts of pedagogy and contents by the youths. Content-wise, they thought science and mathematics are unengaging and decontextualised as they encountered the same topics, same methods, and same information which had existed for decades or centuries. On the other hand there has been a lot of transmissive pedagogy where the information is just conveyed because it must be conveyed irrespective of its relevance and is done to follow the conventions of the subject areas. Moreover, students seem to be more attracted to general science than school science or in other words they are not interested in the basics of science which are taught in schools but the outcomes of the different scientific phenomena included in school science. Because they are attracted to general science, students recognize the importance of science and mathematics only in general terms. On individual terms, the students did not view science and mathematics as that important to them.

Furthermore, the researchers observed the students were having difficulty in identifying with science and maths culture or to be explicit Science Technology Engineering and Mathematics(STEM) culture as well as with the concerned professionals in such domain. As they could not identify with such professionals, they found it hard to adapt to such identity.
What is interesting to note in this study is the students' motivation for choosing STEM subjects in the post-compulsory stage which is impinging on strategic reasons like gaining admission into university of preference, job prospects or high salaries. But much to the disappointment of the students, STEM subjects do not always offer the easiest routes to money and job security as compared to their demands, difficulty and efforts required due to their heavy workloads. The irony here as noted by the students is that they were far from reaping the fruits of their labour owing to the fact that the reality suggests the efforts required in combatting the difficulties in studying STEM subjects exceed the expected benefits by far. With such perception,the expectations of students for success in STEM subjects slid into decline.

Wang (2013) conducted a quantitative study and found out that students' choice of STEM subjects is the result of a direct influence of various factors including the intention to major in STEM, high school mathematical achievement as well as initial post-secondary experiences like financial aid receipt and acdemic interaction. In addition he saw 12th grade mathematics achievement coupled with an exposure to the sciences as having a major impact on students' intentions to major in STEM subjects.Moreover, the students' attitudes toward mathematics and early achievements culminate in maths self-efficacy beliefs.Wang also highlighted the differences in STEM achievements across races wherein a particular race faltered in achievements due to various reasons. Though unconnected with the focus of the study, it is interesting to discover that the race also plays a part in deciding to study science or not.

Naaman (2011) discovered that the most effective contributing factor to students' decisions to study science stems from their interest in that particular science subject. He contended that many students are either hesistant or unwilling to choose science subjects because in spite of the fact that they have studied science in junior high school, most of them were unfamiliar with basic concepts that appear in the science syllabus. Naaman intimated that the more familiar students are with the subject the greater the degree of interest shown by the students and as a result will want to hear and learn more about it.That exposing students to various particular scientific subjects will motivate them to learn more as well as arouse their curiosities. But what is worthy of note in these findings is that though interesting,

the study was carried out on students in Israel which makes generalization difficult since learning contexts differ.

Another quantitative study by Lyons and Quinn(2012), revealed that students consider their science teachers, parents and friends to exert the greatest influence in their choice of science subjects. Conversely, the teachers believed that their students are more influenced by their seniors(older students), peers, friends, siblings and parents. The teachers are convinced that the students' assertions regarding their influence was exaggerated and see themselves as having relatively very little influence on the students' decisions. Though the two groups(teachers and students)differed in their beliefs and views, they coincidentally agreed on the fact that advice from career advisors had little effect or no influence on the latter's decisions about choosing to study science subjects. The contradiction between the two groups is an indication of the ambivalence of one group with respect to its efficacies.The findings from this research is significant for the simple reason that it has some direct link with the role of societal values which is the focus of this work.

Still on attitudes, a literature study by Osborne et al(2010) identified various influential factors with respect to students attitudes towards the sciences.These factors they highlighted include gender, personality, structural variables as well as curriculum variables.The study also revealed the difference in attitudes between boys and girls based on their perception of science. Boys were seen in this study to possess a more positive attitude towards science whereas the reverse is true for girls.

A mixed study by Topinka et al(2008) suggested that students enjoy science and think it is very interesting but ironically not well-liked. Based on responses to the questionnaires it was found out that students' attitudes towards the natural sciences was positive which is a deviation from the findings of Osborne et al.The study also displayed different patterns of students' perceptions of science and scientists that are noteworthy and to some extent influential in their choices.The students characterized scientists as intelligent and diligent individuals but perceive them in their stereotypes as unsociable and unkempt in outlook. Moreover scientists are isolated people who are confined within the walls of the laboratories in which they practice. Scientists are people who are not in sync with the real or outside world. Scientists are viewed by the students through three thespians: In the first extreme position is the scientist whereas in the second is the layman or ordinary man.The former is a producer while the latter is a consumer of what the former produces. The students see themselves as midway or being sandwiched between the two .

Another differing view from that of Osborne et al is a study by Hassan(2011) in which one of the key findings was that students' views of science were positive. Hassan asserted that students' individual responses in his comparative study was an indication that majority of the students both in secondary and tertiary levels viewed science favourably. In general terms and regardless of their grade or level, majority of the students conceded that their interest in science and the enjoyment they derived from it served as the main motivational factors for making it their choice of study. The study also disclosed that most students avoid studying science owing to its negative image emanating from the fact that it is an arduous discipline. By extension, the prevalent views of science held by the participants in the interviews were it was useful because it is intertwined with the well being of humanity. However the study showed that students who do not study science subjects do so out of disinterest and believe inspite of its usefulness to society, it is still a different domain to master all together. And finally due to individual differences and experiences, secondary school students view science less positively than university students.

In a cross-cultural study comprising of students from Malaysia, Turkey, Slovenia and Switzerland, Zeyer et al (2001) used the brain type approach from cognitive science to identify factors that influence the attitudes of students towards science. Prior to the study, sex has been widely considered

to be one of the most significant factors influencing students' attitudes towards science which is in direct contrast with the findings of this present study. The brain type however suggests that motivational differences between girls and boys in learning science does not fundamentally separate them. From the findings it was discovered that the acts of systemizing and empathizing are the two factors that actually differentiate boys and girls and that boys are more motivated when it comes to studying science not because of their sexes but because of their penchant for systemizing. The study concluded that students' brain type which is a basic personal trait is a very significant predictor or determinant for the motivation to learn science than sex. In addition the findings highlighted that successfully improving the systemizing of the low systemizing quotient students, will enhance their cognitive style and could lead to improvements in their science engagement.This study is interpretive and generally it is very difficult to make generalizations from such findings .

Lyons (2007) compared students' narratives from interpretive studies undertaken in Sweden, England and Australia in which core themes relating to critical contemporary issues in science education were identified. Despite the difference in national contexts, the most outstanding issues in each centred on the same three themes. First of these relates to the transmissive pedagogy of school science, a feature so widely discussed that students seemed to regard it as an inherent characteristic.
The second theme involves the personal irrelevance of much of the curriculum's contents which Osborne and Collins found to be a theme of repetition among students regardless of their intention to continue with the study of science (2001, p.449). The third theme entails the perception of school science as a difficult domain which is the most prominent consideration for students' decision about taking science courses in the future. Though the study was carried out in few countries as in the case of Zeyer et al(2001) the findings have exactly outlined where the students' problems in choosing to study science lie and their significance should be appreciated.

The preceding paragraphs report studies undertaken in different contexts which are more generic with regards to science. The studies detailed the views held by students in different countries as well as different continents which in a way can be further generalized. In contrast, from the attempt by Angell et al. (2004), we can see the use of a more subject-specific approach in that physics the focus of the study, was one of the most prominent subjects in the STEM domain. In the study it was discovered that pupils find the subject interesting but difficult and intensively laborious. They see physics as a subject that is more formalistic in nature but still describes the world and daily phenomena.The pupils went on further to convey that outlandish topics like astrophysics are more closer to their lives than mechanics and other topics of similar nature. On the other hand the teachers who also participated in the study, complained about the pupils' poor mathematical skills which the students did not see as any significant problem. The teaching methods and the issue of experiments also came under the spotlight. The findings conceded that physics is still dominated by content knowledge which seems to attract and reward pupils with such disposition and that the pupils do not have any strong understanding of the central role of experiments in science as a whole. Finally the study articulated that pupils would like to see stronger emphasis placed on qualitative and pupil-centered approaches in the teaching and learning processes.

From the information provided above, a number of factors responsible for students' decisions to study science or not have been ascertained. Most of the findings of the researchers seem to be in agreement as indicated in table 1 in the appendix section.

2.3 Summary of findings from the literature

It can be seen that most of the work done in this area has been in the context of the classroom and the school in general. To my knowledge stemming from literature review findings, no one has thought of

exploring the values of the society in which the students live as well as their impact on students' choice of science for study especially at the higher level in secondary or high school and that is where my proposed study comes in. In addition, most of the work on students' attitudes and motivation was done during the 1990s whereas a few has been done in the 2000s. With respect to changing contexts, I think there should be an update in the area and this research is geared towards accomplishing that. For the information of the reader, a detailed analysis of the literature study findings will be found in the discussion section of this work.

Chapter 3

THEORETICAL FRAMEWORK

3.1 Introduction

Two theories that have been effectively used in previous studies of motivation and attitudes in relation to studying the natural sciences by secondary school students are the goal theory and the theory of reasoned action (TRA) or theory of persuasion. Goal theory proposes that goals of learning are the main ingredients that influence the level of a student's intrinsic motivation. TRA on the other hand posits that behaviour is a function of attitude and the intention. In TRA, the attitude is the input which is processed by the intention while the expected behaviour is the outcome.The two theories will be expounded in further sections.
Besides the TRA and the GT, there are other theories that have been used in the study of motivation and attitudes too which will be examined as well, though not as detailed as the TRA and the GT since their use in studying students' choice of the natural science at secondary school level cannot be ascertained.

3.2 Goal theory

Goal theory can be assumed to complement TRA in that it entails motivational behaviour too. The theory posits that students can be oriented towards two types of goals: learning-focused and ability-focused goals. These goals affect the quality of motivation. Students who adopt learning- or task-focused goals are typically interested in learning as an end in itself. Such students are more likely to work hard, choose challenging tasks and persist in learning activities (Ames, 1987; Jagacinski, 1992; Maehr &Pintrich, I991**;** Nicholls, 1984). On the other hand, ability-focused or ego-oriented students are interested in learning as a means of demonstrating their ability , or outperform their colleagues. These students are likely to be concerned with supremacy or concealing their weaknesses, and grades and test scores(Ames, 1987; 1992a; Dweck & Leggett, 1988).

Goal orientations have implications for cognition. Students that adopt learning-focused goals are likely to employ deep cognitive and self-regulatory strategies such as monitoring comprehension and linking new information to prior knowledge. In contrast students that adopt ability-focused goals tend to use superficial strategies like memorizing and writing down the first thing that comes to their minds in order to finish a task quickly (Ames & Archer, 1988; Elliott & Dweck, 1988; Graham & Golan, 1991; Nicholls, Cobb, Wood, Yackel, & Patashnick, 1990; Nolen,1988; Nolen & Haladyna, 1990).

According to evidence from theory and research teachers also influence the goals pursued by students through instructional practices and procedures (Ames, 1992b; Ames & Archer, 1988; Anderman & Maehr, 1994; Meece, 1991; Meece, Blumenfeld, & Hoyle, 1988).

The strength of a goal theory approach in analyzing motivation in science education is that it has identified specific classroom practices and procedures that contribute to students' adoption of a particular goal orientation (see Ames & Archer, 1988; Anderman & Maehr, 1994). The goal theory seems to be a more pragmatic approach.

3.3 The theory of Reasoned Action

The other theory is the theory of reasoned action. Fishbein and Ajzen (1975) formulated the theory of reasoned action or TRA and was used by Anderson and Young to examine individual and classroom-level differences in motivation in sixth- and seventh-grade middle school science and the outcome had been encouraging.

According to Fishbein and Ajzen, the TRA contends that a systematic relationship exists between attitudes and actions or behavior. The aim of the TRA they claim is to explain volitional behaviours and assert that the strongest or most proximal predictor of volitional behavior is one's behavioural intention. Behavioural intentions are thought to be the outcome of both an individual or attitudinal influence and a normative or social influence. The individual influence on intention is a person's attitude towards performing the volitional behavior whereas the normative influence is what Fishbein and Ajzen referred to as one's subjective norm (Hale, Householder and Green,). To add to that, some of the works of Simpson and Oliver (1990) has gone further to embellish the relationships between school and classroom variables(classroom climate, curriculum, teachers' instructional practices and other students) and attitudes towards science, finding that students who perceive these variables as positive environmental factors are likely to have a positive attitude towards science. It has also been shown consistently by previous studies in motivation in science that attitudes towards science influence achievement (Haladyna & Shaughnessy, 1982).

Anderman and Young(1994) have used the two theories as frameworks in their study which yielded positive results though it was in another context. In their concluding remarks it is mentioned that one of the frameworks, the goal theory, is in consonance with Science, Technology and Society (STS) reforms in science education (NSTA,1991) and can be effectively used in addition to curricular reforms to provide equal opportunities for all science learners (Linn, 1992;NSTA, 1991). Thus, to borrow from Maehr (1976*), the use of a goal theory approach to student-motivation might enhance existing science reform programs, making it possible for a wider variety of students to continue to engage in science education*.

Whereas the TRA is more inclined to students' attitudes, the goal theory on the other hand is more motivation-prone. As the two are seen to be complementing each other, the TRA which is about attitudes and intentions can be said to be the means while GT which is behaviourally-inclined can be likened to the end.
Furthermore, in the deduction of Simpson & Oliver (1990), the TRA demonstrates that the school and particularly classroom-related variables (like classroom climate, curriculum, teacher practices, other students) have a significant impact on adolescents' attitudes toward science which makes a combination with the GT worthwhile. Consequently, as if buttressing my claims, findings by Anderman and Young showed that a multi-framework approach can be used in science education research as had been successfully done in their work in 1994.

3.4 Other approaches

In addition to the TRA and Goal theories several authors have also used different approaches to understand young people's choice patterns on the premise that their educational decision-making is complex in nature. In psychology theorists have linked educational choices to individuals' personality types (Costa ,McCrae & Holland, 1984;Head and Ramsden , 1990). On the other hand sociology has

understood educational and vocational behavior as products of socio-economic factors such as social class (Ball, davies, David & Reay, 2002; Bourdieu & Passeron, 1990). Approaches to academic motivation include the *self-efficacy theory*(Bandura, 1997), *intrinsic and extrinsic motivation*(Ryan & Deci, 2000), *interest development* (Hidi & Renninger,2006; Krapp, 2005), *attribution theory* (Weiner, 1985) and *expectancy-value theory*(Eccles, et al., 1983).Based on the information the researcher has gathered so far, none of these theories has been used in the context of the natural sciences but the fact remains such theories are worth-mentioning since they bear some relationship with motivational behaviours.

As my study entails social values in relation to attitudes and motivation, I am therefore going to use two theoretical frameworks as a guide. Thus I will conduct my study within the frameworks of the Theory of Reasoned Action and the Goal Theory which have already been expounded in previous sections. Within these two frameworks, there is the potential to know whether students will be motivated to study science on account of individual or collective goals or attitudes induced by the values of the society or on account of both.

The foregoing sections have described the two theoretical frameworks to a large extent and the description has been followed by the description of other theories which have not been chosen because of suitability reasons. Now this researcher will collect data for this study within the confines of the two theories and will have to examine it through the lenses of the chosen theories. In other words this researcher will use these theories to seek answers to questions regarding students' attitudes, intentions and motivations in choosing to study the natural sciences at the higher secondary school level and whether there will be any connection with social values. But will students' attitudes towards social values culminate in their intention to become science-related professionals? Will the goals and aspirations of students be dictated by social values? Will the participants in this study choose to study the natural sciences along the lines of these two theories? Are students motivations really guided by their attitudes and intentions as suggested by the two theories? Will the data really corroborate the claims from the two theories?
Finally, if these two theories hold or what they propose is true then this researcher expects to find answers to these questions and vice versa.

Chapter 4

RESEARCH DESIGN

4.1 Introduction

Focus group interviews and interactive discussions were held with students in an English medium secondary school. The interviews were conducted to underpin the discussions. The participants were sampled mainly from the higher secondary school level population. Included in the sample were students who have opted to study science at higher secondary school level as well as those who have opted to study non-science subjects. The interviews and discussions centered on specific ROSE diagrams (graphs) illustrating key findings from research conducted in member countries on important issues directly connected to science education and awareness. It should be noted that though the participants will be 17 and above, the ROSE data discussed was collected from 15- or 16-year-olds.

4.2 Research methodology

The research conducted was qualitative and ethnographic. The research was based at the Hvitfeldska Gymnasiet, a high school situated in Gothenburg, which is the second largest city in Sweden. It will be interesting to note that the chosen school is one of the few schools in Gothenburg that operates within a local and international system of education employing both Swedish and English as languages of instruction especially at advanced levels. Another note-worthy feature of the school is that the student population in the higher level of the school is an interesting mix of what for the purposes of this study will be called—assuming their self-evident meaning but without any intention of stereotyping—locals and internationals.

The ‘locals’ include students who were either born in Sweden by Swedish parents or by immigrants or were adopted at a tender age. All of them started their basic schooling in Sweden and can also speak both English and Swedish. Though they are considered locals, the students are also familiar with the international curriculum known as the baccalaureate.

In contrast, the ‘internationals’ include students with different backgrounds who accompanied their parents during migration or job postings. These students had part or most of their basic schooling in their respective home countries which include India, France, Iran, Iraq, Somalia, England, Singapore and Nigeria.

Based on the researcher's criteria, a population of 24 students volunteered and participated in the research process which was facilitated by two teachers who taught chemistry and the English language respectively. The participating students were from among those who study subjects unrelated to the natural sciences as well as those who study at least one subject related to the natural sciences. With such composition, the students were split into two groups namely: the non-natural science group and

the natural science group.

Of the participants, 18 were girls and 6 were boys and were evenly distributed to each group viz:- 9 girls and 3 boys. Fortunately for the researcher there was no student in the population that studies subjects from both the non-natural and natural sciences.

Before the research was conducted, the researcher visited the school and held a meeting with the students facilitated by the teachers. During the meeting the researcher spent about thirty minutes to explain the concepts “social values”, “attitudes” and “motivation” so as to prepare the students for the research process.

The research process proceeded on two successive tracks: 1) An interactive discussion and 2) Interviews. Since the students were in their teens and still under parental care, the ethics of informed consent was observed in that they were carefully briefed by the facilitating teachers on what the researcher's intention was and what to expect. With the permission of the participants, each part of the proceedings was video-recorded by the researcher for the sake of future analysis.

4.3 Interactive discussion

The interactive discussion comprised of two sessions with the two groups group participating in turns. It was based on data collected from a ROSE survey carried out among students in developing and developed countries relating to their opinions on school science and science as a whole. Based on availability, the non-natural science group had the first session while the natural science group opted for the second session. The objectives of the discussion were to figure out if the students share the same views about science as their counterparts in the developing world and also to explore their science consciousness coupled with their inner feelings regarding those views .

In total, four slides(see appendix) containing some ROSE data (described in 4.6) were displayed on a screen with the help of an overhead projector. A time of twenty minutes was allocated to discussion on each slide with each student in the group allowed to make at least one contribution. The researcher who was overseeing the discussion was playing the role of a moderator by doing intermittent prompting and guiding aimed at ensuring that the discussion did not sway from the contents of the slides. In most cases the researcher had to ask questions to either kick-start the discussion or to put it back on track when necessary.

4.4 Focus group interviews

According to Morgan (1998a), a focus group is a kind of group interview in which 6 to 8m persons under the guidance of a moderator elaborate on a topic. A focus group study may be used for various purposes (Folch-Lyon & Frost, 1998) and in this case was used to complement the qualitative data and help the researcher to have a thorough insight into the participants' thoughts, feelings and motivations.

The interviews were held in subgroups of four and six to complement the discussions and followed immediately after them. There were three subgroups of four comprising of students from the non-natural science group whereas from the natural science group there were two subgroups of six. The same questions were asked to each group and each group member is allowed to respond individually. The researcher was playing the dual role of moderator-interviewer which was necessary to enable the students to be more explicit and articulate in their responses when required. There was no stipulation on the duration of a response because the researcher wanted the students to feel at ease and so take

their time to give the appropriate responses. Details of the discussions and interviews can be found in the ensuing chapter.

4.5 The researcher's role

Ethnography is a peculiar human endeavour and the practitioners believe, unlike other approaches in research, the researcher is the fundamental tool for collecting fundamental pieces of information that make up the research data (LeCompte, Schensul,& Weeks;1999). Amassed in the Ethnographer's principal database during the interaction with humans are direct observation, face-to-face interviewing and elicitation, audiovisual recording and mapping the networking times and place in which the human interactions occur. It is against such background that the researcher in this work played his role and in this case as a participant observer.

Participant observation is the most important data collection strategy used by Ethnographers (LeCompte et al).The main doctrine in participant observation is that the Ethnographer comes to understand the human subjects he studies through engaging them. For instance people are more likely to discuss freely their experiences if they feel comfortable with the researcher i.e. if they feel the researcher can identify with their joys and difficulties.

Being a participant observer, this researcher employed the strategy of more observation and less participation so as to limit or minimize any bias. During the observation, the researcher, though within the environment, did everything possible not to make his presence felt by playing the 'silent spectator' making the participants feel at ease and free from any external influences. Participation which was ephemeral and intermittent only occurred as a guiding act.

4.6 Analysis of data

To start with, the data is qualitative and was collected using the research method known as Ethnography. It includes video recordings of interactive discussions and focus group interviews of the participants in the research.

The analysis on the interactive discussions was done slide by slide. The researcher had to carefully watch and listen to the audiovisual recording several times and taking notes at the same time. For every repeat of the act, the researcher will compare whether he had recorded the same thing in writing so as not to miss any important detail. After the recording, the researcher had to read through what he had written so as to identify the various themes that resulted from the participants' responses. The themes formed the basis or focus of the compilation.

In the case of the interviews the analysis as in the case of the interactive discussion was done question by question. The response to every question was reviewed several times for each participant so as to understand the contexts properly and also to avoid any misrepresentation of facts. While reviewing the responses the researcher was also taking notes so that no important detail will be omitted. The notes were also later reviewed and compiled.

The researcher labelled each set of data on basis of the two groups. Interview data as well as discussion data collected from the natural science group was so labelled and the same was done for the non-natural science group too.

Details of the two analyses will be seen in chapter 5.

4.7 Methodological background of ROSE

ROSE is an international comparative research project meant to shed light on factors of importance to the learning of science and technology as perceived by the learners. Many actors have been involved in the process of developing the ROSE instruments and its data guidelines. The guidelines for data collection (population, sampling, logistics, data coding etc.) have been developed in collaboration with

international partners. ROSE has an international advisory team of science educators from all continents.

One key objective of the ROSE is to collect data on students' (age 15 or 16) experiences, interests, priorities, images and perceptions that are of relevance for their learning of science and technology and their attitudes towards the subjects.

ROSE data are currently being collected in some 35 different countries and about 10 PhD students in many countries will use national and international data from this collection as a basis for their thesis. It is to be emphasized that ROSE is not a test for conceptual understanding of science concepts rather, it is meant to gather information of attitudinal and emotional nature held by students. More explicitly, the ROSE instrument tries to describe the science and technology-related experiences that students have, the kinds of interests they have

for science and technology and what views and attitudes they have towards science and technology in society. ROSE is funded by the research council of Norway, the Norwegian ministry of education, the university of Oslo and the national centre for science education (C.Schreiner, & S.Sjøberg, 2004).

The ROSE data has been successfully administered in most member countries of which Ghana is a classic example (I.K. Anderson, 2006). There are also numerous publications authored by doctoral students and professors from different member countries which include a variety of topics and projects.

4.8 Limitations

In a work concerned with the problem at hand the key probable terms are students' attitudes and interests. These terms are not easy to define and because they overlap are not easy to measure. Attitudes and interests are temporary and are subject to change (Jidesjö et al., 2009). But reviewed literature indicated that such study had successfully been previously done. Furthermore, the subjects in this research are upper secondary school students who study in the same school and so there is a remote possibility that their views might or might not reflect those of students of the same level in other schools.

Chapter 5

DATA

5.1 The Interactive discussions

As had already been mentioned in 4.1, the researcher played the role of a moderator which can also be likened to that of a participant. The discussants belonged to two groups with different ideas about science: one group comprised of students that do not study any subject pertaining to the natural sciences while the other group comprised of students studying at least a subject pertaining to the natural sciences.

5.1.1 Slide One: I WOULD LIKE TO BECOME A SCIENTIST

Most of the discussants shared almost the same views about students in the developing countries on the desire to become scientists when this researcher inquired about the results shown by the figure(See appendix). Though the decision should be individual the information the figures divulged tend to be more collective as if the same thoughts had been running through the minds of the students in that part of the world.

Students studying the non-natural science subjects think that most students in the developing countries would like to become scientists because their countries are poor and underdeveloped and so need more scientists to take them out of their current predicaments.

Equally, students studying the natural sciences believe that in the developed countries most of the inventions and innovations have been done and are now commonplace whereas in developing countries most of the concepts are still new or undiscovered. Furthermore students in developing countries are inclined to become scientists because they want to make their own contributions towards developmental changes in their societies whose need is not felt anymore in the developed countries.

The students are also of the firm conviction that natural science in developed countries is not interesting anymore giving the fact that phenomena, theories and principles have been the same from time immemorial and the same knowledge has been handed down from generation to generation.

The other problem also cited by the students is that science is sort of slowing down in developed countries in that the population of science-related professionals is on the rise while job opportunities are decreasing day by day. The rat race among science-related professionals for jobs is prompting most students to choose to study subjects other than the natural sciences.

Some students see social values like prestige and status as factors responsible for the desire of students in the developing countries to become scientists. They noted that in developing countries like India,

families force or encourage their members to choose the path of natural science not only to enhance the reputation of that family by bringing pride and prestige but also to be financially stable or secure since such professionals are well-paid and complement the development of their societies.

When this researcher raised the question about the boys' outnumbering the girls in the desire to become scientists, the students were unanimous in their responses. The girls believe that natural science-related professions suit the boys more than the girls and that traditionally, most famous science-related professionals have been males and so seeing more boys interested to become scientists as opposed to the girls in developing countries is not surprising. This belief was shared and reinforced by boys when they added that girls are a socially-oriented sex group with the habit of working with people rather than equipment or machines. The researcher saw this belief held and shared by the boys as an attempt to stereotype the girls which can work in some cases.

The observation that can be made according to the perceptions of these students is that their colleagues in the developing countries are motivated to study the natural sciences because they want to scientifically change or develop their societies whereas the former do not have such motivation since technological or scientific advancement is nothing new.

5.1.2 Slide Two: I LIKE SCHOOL SCIENCE MORE THAN ANY OTHER SUBJECTS

On this slide the non-natural science group deduced from the red and blue dots on the figure that in developing countries students like school science better than most of the subjects unlike students in the developed countries and that the difference between boys and girls is negligible. The discussants also observed that in the developed countries, especially in Europe, boys like school science more than their female counterparts

When this researcher posed the question regarding such different attitudes of students towards the natural sciences in both developed and developing countries, most of the responses mainly centered on the former. They believed that in the developed countries, school science is not as interesting as that on TV and that the teaching methods are boring being that the teachers do not add any extra effort to capture the interest of students.

On the other hand the natural science group claimed students are losing interest in school natural sciences because most of the science studied in school is not interesting since no practical application is employed. Everything is just theoretical and not realistic.

A student cited an example in the Nigerian context where laboratory facilities are poor or not even available. He explained the behaviour of students in relation to their interest in the natural sciences giving biology as an example. From his explanation most students like biology more than other natural sciences because they think it is interesting and easy to understand and believe that as the subject deals with living things they can relate to most of the things taught in class. He mentioned that because students enjoy what is being taught in class they are motivated to follow their lessons with practice at home. For instance, students dissect insects at home to see the different parts or search for organisms in their habitat to see how they live.

Another student claimed in England students perform laboratory experiments themselves which develops interest and participation whereas on the contrary, in Sweden, they are merely silent spectators due to the lack of provision of enough materials that enable students to set up and perform experiments on their own. This means the mere expectation that a student will perform experiments in the laboratory sparks interest and motivation.

This researcher also posed the question "Does that mean the teachers do not make science interesting in developed countries?", so as to extract more information from the students. In response the students lamented that teachers do not care whether they liked the natural sciences or not. Consequently, they went on, a wide gap exists between students and the natural sciences unlike the non-natural sciences which are more closer to them. They cited subjects like psychology and economics as classic examples since they deal with human behaviours.

From this slide based on the discussions and examples cited by the students, we can see that motivational mechanisms differ between developing and developed countries as in the case of Nigeria and England if we go by the students' narratives. What more while in Sweden according to the discussants from the natural science group, the students watch things happen in the laboratory, it is the opposite in England. But that does not mean the students in Sweden are not motivated though maybe they could have been more motivated.

5.1.3 Slide Three: SCIENCE AND TECHNOLOGY CAN SOLVE ALL ENVIRONMENTAL PROBLEMS

When the students were asked why such belief is stronger in the developing countries, the non-natural science group could offer only one explanation impinging on the non-availability of technology in the developing countries. Students in the developing countries hold such strong belief about the environment, the discussants went on, because their exposure to technology is limited. They made mention of green cars which they claim are still yet to be used in the developing countries. Due to their laconic responses it was apparent that their knowledge on environmental issues was rudimentary.

The natural science group on the other hand seemed divided on the belief of students in developing countries that science and technology can solve all environmental problems. Some believe that in developing countries students hold such strong belief because they are not so conscious about the environment and its problems. Others differ by hinting that indeed these students are conscious of environmental problems owing to the situation in their less advanced countries and so have developed such belief.

The students held the view that students in developed countries do not share such strong belief as their counterparts in the developing countries for various reasons. They believe science and technology are not enough to solve such problems but also stringent regulations and policies with the required money to back enforcement which are not present in the developing countries. They also believe that students in developed countries are already conversant with such technology—they have seen how it works and the outcomes and so will not be moved whether by an existing or emerging technology to warrant them holding such strong belief in line with their colleagues in the developing countries. The other reason they cited is that in the developed world there is so much skepticism towards science and its solutions whereas in the developing countries there is great optimism. Some students implied environmental issues are all politics because there is still no lasting scientific solution in sight.

5.1.4 Slide Four: SCHOOL SCIENCE HAS SHOWN ME THE IMPORTANCE OF SCIENCE AS A WAY OF LIVING

Here again the non-natural science group attributed the positive responses of students in developing countries to backwardness in comparison with those in the developed countries. When asked by the researcher whether they agreed with the responses of their counterparts in the developing countries, their responses were mixed. Some completely disagreed while others admitted school science has only

affected their way of living to a small extent. They complained that not everything about science is taught in the schools and the level of scientific knowledge imparted in them is shallow. They also claimed that the importance of science for their way of living has not being impressed upon them during school lessons.

For the natural science group, school science in developed countries is like a kind of brainwashing process where they are made to accept whatever is written in the books and that most of the learning is not realistic in that the application does not always seem to be the same as what is in the books. There was also the belief that students in developing countries hold the views that school science has shown them the importance of science for their way of living because overall, unlike their counter parts in the developed countries, science means so much to them. Some of the discussants also believe that in developing countries students are taught science in school and left to figure out or digest what they have learned at home which culminates in the above belief.

5.2 Summary of the interactive discussions

The views of the students exposed two significant problems they in the developed countries are facing in science. The first problem is that of the attitudes of the science teachers towards developing the interest of their students and from the students' responses, that leaves much to be desired. There has been so much negativity on the teachers' side regarding their desired high school outputs and their attitudes can be further described as non-committal owing to the fact that they de-motivate the students much to their chagrin. The second problem is the teaching methods employed by the teachers which differ in different learning contexts. According to some students the teaching methods which are supposed to be captivating or spellbinding turn out to be the most unengaging they have ever thought of which is also another recipe for de-motivation and disinterest. And last but not the least the students seem unappreciative of the traditional knowledge imparted in them by the teachers and believe it is a kind of brainwashing exercise in which they have no option to question except accept and move on.

5.3 The focus group interviews

In this segment of the data collection process, the researcher played the role of the interviewer and the setup was the same as that for the discussions. Five simple and straightforward questions were posed to students of each group whose members in turn responded individually to each question. It is to be noted that out of the five questions two of them were specific with each targeting a particular group. The interview sessions proceeded as can be seen in the ensuing subsections.

5.3.1 WHY DID YOU CHOOSE NOT TO STUDY THE NATURAL SCIENCES?

This question was posed specifically to students who study subjects that do not relate to the natural sciences. The responses to this question range from a dislike, disinterest to inability.

Most of the respondents thought subjects like physics and chemistry are very difficult and so need extra efforts to follow. Some admitted they like the natural sciences but are not intelligent enough to study them especially when they are weak in mathematics. For some, notably the girls, the teachers in the lower secondary school as well as the teaching methods were not motivating and so they didn't find the contents of the natural sciences interesting enough to appeal to them. The teachers they claimed were not committed to making science a fun to study. From their responses majority of the students in the non-natural science group would have liked to study the natural sciences but are

impeded by their weaknesses in mathematics or anything that has to do with calculations.

However, most of the respondents choose to study the non-natural sciences because they believe, being interested in human behaviour, subjects like psychology, economics etc. are the right choices and also as they have plans to make working with people their careers, they believe those subjects are more compatible.

5.3.2 WHY DID YOU CHOOSE TO STUDY THE NATURAL SCIENCES?

This question was posed specifically to students that study subjects related to the natural sciences. Most of the respondents were either influenced at one time or the other by either their parents or their teachers and have been exposed to activities that have to do with the natural sciences which had since aroused their interests. The professions of most of the respondents' parents are science-related and yearning to emulate these parents was the driving force behind choosing to study the natural sciences. Some of them cited future career prospects, prestige and family values as reasons for choosing to study the natural sciences.

There is also a common belief among the respondents that studying the natural sciences elevates their social standing especially those who are inclined to pursuing careers within the medical and engineering fields.

5.3.3 IS SCIENCE AN EASY DISCIPLINE?

Most of the respondents in the non-natural science group believe subjects related to the natural sciences are difficult and need extra efforts which they cannot provide buttressing reasons given in the first question.

As for the natural science group, they see science as more challenging than difficult but on a specific note, they see school science as less difficult. They believe the ease or difficulty of science is contextual and dependent on what areas the student has covered and the teaching method. For instance some students view subjects like chemistry and biology as complementing each other with the similarities that make them very easy to grasp while others see physics as a very difficult subject that is calculation-dominated. One of the common problems they have with natural science subjects is accepting without questioning or proving which normally culminates in a lot of memorizing without even understanding.

5.3.4 ARE YOU GOOD IN MATHEMATICS?

All the respondents in the non-natural science group responded negatively to this question as can be seen in the earlier stages of this interview. On the converse respondents in the natural science group were either just good or very good in mathematics since it is a key to their career prospects. What is ironic about their responses is that most of them dislike mathematics but are good in it and have to keep studying it because of its ubiquity in the natural science domain.

5.3.5 ARE YOU PLANNING TO GO INTO BUSINESS SOMEDAY?

Nearly all of the respondents in the non-natural science group are not interested in business and so are not having any plans to involve in such venture in the future. The natural science group on the other hand differ as was noted in their responses. Some of them would like to own science-related firms while others would like to engage in business encapsulating creativity, talent or concept trading or exchange.

5.4 Summary of the interview responses

Clearly, some students would have really loved to study the natural sciences if they had the ability which embodies laborious work, mathematics, problem-solving skills, etc. Teaching methods and attitudes of teachers have also been cited as reasons for not developing the abilities to study mathematics and the natural sciences.

Other students report thinking that the natural sciences are not easy to deal with but have no choice because future careers dictated their competencies. It is also interesting to note that all the respondents in the non-natural science group are weak in mathematics while the natural science group respondents have no problems with it, though some detest it but have to come to terms with the reality that it is a key to their science-related careers. Most students in this sample would like to go into business someday, though that is not their motivation for studying the natural sciences.

In a nutshell, the interviews have revealed that most students' motivations for studying the natural sciences are triggered by a surprisingly narrow set of factors: family influence or expectations, career prospects, job status, teacher influence and personal prestige.

Chapter 6

DISCUSSION

6.1 Introduction

In this work the questions under the spotlight have to do with what students in Europe (Sweden) perceive as the role(s) of social values in their choice of the natural sciences for study in the upper secondary school. The values identified or discovered in this study have to do with the family, parents, friends, peers, siblings, teachers, professionals and money.

Findings from different segments of this study reveal that students see social values as having both motivational and attitudinal roles which influence their decisions to study the natural sciences as will be seen later in this chapter.
Also, as will be seen later in sections 6.3 and 6.4 there has been a lot of display of attitudes, intentions, behaviours and motivations with regards to choosing to study the natural sciences which is in line with what is being proposed in the GT and TRA the frameworks within which the study was done. Though proving the two theories is outside the scope of this work, it should be considered by any reader that mentioning any agreement by the data with those theories is not misplaced because this researcher believes it is important too. Furthermore the data in 6.3 and 6.4 will be discussed from two perspectives or contexts. The first will be in the light of students in the developing and developed countries and the second will be in the light of the students who study the natural sciences and the non-natural sciences.

For the sake of clarity and for the benefit of the reader, the students involved in this chapter belong to

four categories or groups:
i)Students in the literature study
ii)Students in the developing countries related to the ROSE graphs
iii)Students in the developed countries also related to the ROSE graphs and
iv) Students who participated in the interactive discussions and focus groups interviews in Sweden. These students are often referred to in this discussion chapter as participants and are the focus of this study.

6.2 Findings from the Literature Study

From the literature has emerged a plethora of reasons in relation to students' motivations and attitudes concerning their choice of the natural sciences at high school. Some of the views or findings of different researchers seem to be in agreement while some seem to be in conflict or on different tracks. Though most of the studies are not directly linked to the role of social values, their significance in highlighting the motivational and attitudinal aspects of the students' behaviours in relation to their decision to study science cannot be underestimated. A fact worth mentioning is that at the inception of this study, it was imperative to highlight or project the various reasons for studying science which are not only relevant but of paramount importance because embedded in them might be what the researcher is seeking. We can also note from the findings that the practise of choosing to study the sciences at the post compulsory level in high school is more engulfed in attitudes and motivations which are in turn driven by perceptions, contexts and influences.

The findings indicate, one of the big problems students are having with choosing to study science is the image of science being portrayed by different sources. The students view science favourably and perceive it as useful because it is inextricably linked to the well-being of humanity but the negative images of science remain an inhibitor in their choice plans and leads them to avoid choosing to study anything pertaining to that domain(Hasan,2011;Bøe et al 2011). In addition the assessment system is also considered to be more about performance learning rather than mastery learning for understanding. The perception of scientists is also a make-or-break in the process of choice- or decision-making.

Furthermore, most of the students in the literature findings view scientists as people having a particular culture with specific traits and thus differed on their choice of science(Topinka et 2008). Those students that choose to study science see scientists as potential role models in that they perceive them as more intelligent, diligent and highly motivated(Topinka et 2008). Most of these students are motivated to study science so as to gain admission into a university of preference, increase their chances for well-paid jobs as well as secure fat salaries in the post-high school stage. Their science choice is in most cases influenced by an intention to major in a particular science subject, high school mathematics achievement and attitudes towards mathematics and mathematics self-efficacy beliefs. These students are referred to (according to their brain-type) as systemizers by researchers like Zeyer et al(2011) who discovered the relationship between motivation to study science and the act of systemization. Their findings showed the more the systemization, the greater the motivation to study science and vice versa.

While the previous or pro-science group sees scientists as people worthy of emulating, those who do not study science find it hard to identify with the science culture as well as the professionals in the domain. They perceive scientists as unpopular, unsociable, unkempt and shabby in appearance, less creative and less emotional(Toyinka et al, 2008; Taconis & Kassels, 2009). For these students scientists are individuals who are isolated from the real world and spend their lives within the walls of the laboratories they do their work. Students see themselves as sandwiched between the scientist and the layman and see the latter as a consumer of the former's products. As far as these students are

concerned, their interest in science is null because they harbour the belief that it is a totally difficult domain to master despite its usefulness to the society.
Due to their perceived outlandish culture of scientists, these students find it difficult in seeing themselves as people aspiring to be scientists.

Also, students see science especially school science as a non-appealing domain due to their perceived inability to utilize its knowledge in real world situations after having spent all their time in studies inspite of all the encountered difficulties (Lyons & Quin, 2010). In furtherance of such perceptions, the students who do not study science are disenchanted with realities having to do with post study situations where there are mammoth expectations in relation to well-paid jobs or higher salaries. Much to the chagrin of their colleagues in the opposing side, as demanding and as difficult the study of science is, they do not always seem to reap the benefits of such labour. In a nutshell the labour most of the time far outweighs the benefits. So we can see that with such perceptions or concerns the students' expectations of success in studying science slid into decline.

The findings revealed the impact of influences of personalities and other factors on students' subject choices which can be negative or positive or middle-of-the-road. While the influence of scientists has been viewed differently by the students, they still consider teachers, parents and friends to have the greatest influence on their subject choices though the teachers on the other hand thought their influence is of less significance (Lyons & Quin, 2012). The teachers in turn believe students are more influenced by their peers, seniors, siblings and parents.

Exerting influences on students' choices as well as their attitudes towards the sciences also include contextual factors like family, gender, and personality, structural as well as curriculum variables. However some researchers found out that there is no single way of accounting for choice patterns giving the fact that students do have different reasons, circumstances backed by their dispositions, interest future plans and choice-making experiences. Now these findings are significant as they have a direct bearing on this work.

Prominent in the literature study also is the issue of the continuous decline in interest in school science and mathematics among young learners. The pedagogy has been called into question and characterized as being inherently transmissive while the contents have been considered unengaging and decontextualized (Lyons, 2007;Bøe et al 2011). The information and methods are the same that have been existing from time memorial. There is no novelty in the science pedagogy where following conventions is given priority over relevance of conveyed information. This has resulted to a greater disenchantment with school science culminating in students regarding science and mathematics as having a more general importance than a specific or personal one. The perception of difficulty also affects their expectations of success which is lower than those in other non-school science subjects(Lyons, 2007). The students are more attracted to general science than school science.

There has also been a kind of inverse relationship with regards to improvement in students' interest in the study of science. According to the findings, the higher the students go in high school, the more difficult science becomes and the lower their interests(Bøe et al, 2011).

Buttressing the above findings, a contextual study on choosing science revealed that physics is an interesting subject but laborious(Angell et al, 2004). Physics is formalistic in nature but notwithstanding; it describes everyday phenomena and the world.

Students, according to the findings, perceive the subject as too far from their lives unlike subjects like astrophysics that seem closer and though teachers complain about their poor mathematical skills they

don't consider that as any serious problem. The students in the study thought physics is still being dominated by traditional content knowledge that does not offer anything new(Angell et al, 2004). The students in their evaluation believed more student-centred and qualitative approaches are absent in the teaching and learning of the subject and are the need of the hour. This finding, this researcher believes embodies in one way or the other most of the findings in the preceding paragraphs.

Further subsections will elicit and elucidate students' opinions and attitudes concerning the study of science by students in the developed and developing countries, school science and science as a general phenomenon. In the further subsections findings from a real situation or an Ethnographer's perspective will be discussed and it will remain to be seen if they will match those in this literature study.

6.3 This study: Results from the Interactive Discussions

The findings from this discussion are revelations of the attitude of most students towards science and are based on the ROSE graphs(see apendix B). Most of the attitudes towards science as observed from the reactions were mixed: positive especially for those students studying the natural sciences though there were a few exceptions and negative for mainly the non-natural science students. It is to be noted that the participants in this discussion are students in the developed world and were discussing about students in the developing world.

The non-natural science students were of the opinion that students in the developing countries are interested in science and want to become scientists because their countries are poor and underdeveloped and believe science-related professions can help them contribute immensely towards developing their countries. This view was alsoshared by the natural science students who in addition also believe that students in the developed countries are not so much interested in science or becoming scientists because innovations or inventions are nothing new in their societies and occur frequently, while it is the reverse for students in the developing countries hence, their interest in science and propensity to become scientists.

Findings also suggest that students in the developed world are not so motivated to study science or become scientists because according to them science is not exciting or interesting anymore for the simple reason that phenomena, theories and principles are the same that have been existing, taught and learned for generations buttressing findings by Angell et al(2002) and Bøe et al(2011) in the literature study. The students thought their motivation to be scientists or study science is witnessing a considerable decline owing to the fact that the prospects for a science-related profession is dwindling or fading owing to the existence of a large population of unemployed science-related professionals as also highlighted by Bøe et al(2011).

Students also believe that overall social values like prestige and status are some of the factors responsible for students' motivation to study science or become scientists mainly in developing countries. For instance in African and Asian countries some students intimated, families influence school-going members into studying science not only to enhance the family reputation or social standing but also to land lucrative jobs as discovered by Bøe et al(2011) .

Findings show that in the developed countries science is liked mainly by boys as compared to girls but in contrast it is equally liked by boys and girls in developing countries since everyone is craving to be a scientist or some science-related professional(see appendix B). The students hinted that in the developed countries school science is not as interesting as science broadcast on television and lamented the teaching methods employed by teachers as ineffective, repetitive and boring which is in agreement with the findings of Osborne and Dillon(2008) and Terry Lyons(2007). To make things worse, because of the teaching methods or approaches, a wide gap exists between the natural sciences

and the students. One student in the non-natural science group regretted for not studying science due to the above reasons and wished to do so if he goes back in time().

In comparing the differing views on science, there was a lot of skepticism on the part of the students in the developed world (and in this case the participants from the natural science group) who thought for instance science and technology are not the only solutions to environmental problems but rigorous legislation backed by financial support. The students were of the view that school science as mentioned earlier contains traditional contents that are far from reality and too formalistic. They complained that the knowledge imparted to them in school is shallow and leaves much to be desired.

On the other hand, students in the developing countries had an optimistic view on science and technology and hold the belief that the two are the possible solutions to their environmental problems. All in all they are more positive than their colleagues in the developed countries.

We have seen that most of the students in the developed world have such a laidback attitude towards science because of reasons already stated and so are not impressed by advancements in technology and science. In agreement with the TRA and GT, for those participants who do not study the natural sciences, their goal intentions do not include becoming professional scientists or technologists as indicated in their behavioural intentions but for those who study the natural sciences it is the exact opposite. It is a matter of attitudes, intentions, behaviour and motivation as is proposed by Fishbein and Ajzen(1975) and the goal theorists.

From the participants' viewpoint, students in the developing countries are not so exposed to technological or scientific advancements so their propensity as already stated is to change or improve their societies. Their goal intentions are geared towards becoming scientists or technologists as valued by their societies while studying the natural sciences is their behavioural intention. In the same vein also the participants in the developed who study the natural sciences also believe that studying the natural sciences which is a behavioural intention can earn them money and status in the individual level and family prestige in the collective level which are their goal intentions. Again we can sense an agreement with the theoretical frameworks here.

All in all the mixed responses of the students in this interactive discussion reflect their differing attitudes towards the natural sciences which is an indication that choosing to study the natural sciences is an attitude decision and the singular act of participating in the classes is behavioural. Now this lends credence to the belief that attitudes influence behaviours which buttresses what Fishbein and Ajzen(1975) proposed in the TRA. Also it is clear that those students with positive attitudes do favour the natural sciences and so choose them for study keeping their goals in mind and these goals have to do with the values of their society. Even though we are talking about attitudes in this subsection we should not underrate the fact that positive attitudes may lead to positive goals which are recipes for motivation as the GT proposes.

6.4 This study: Results from the focus group interviews

Responses from the focus group interviews revealed a myriad of reasons in connection with the choice of the natural sciences at the higher secondary school level. This researcher would like to make it clear that all the participants in these interviews are students in the developed world.

Findings indicated that most of the students in the interviews choose not to study the natural sciences because of dislike and disinterest and the inability to perform mathematical operations as required in subjects like physics and chemistry. Again with physics and chemistry under the spotlight students thought science is difficult since it entails a lot of laborious work which they could not stand incessantly confirming the findings of Bøe et al(2011). Some students professed they liked science but lacked the competence or self-efficacy needed in subjects like mathematics and went on to blame the teachers and their teaching methods for not doing enough to boost their motivation. In consequence they never found the contents of physics and chemistry appealing or captivating. In sharp contrast some students admitted they did not choose to study the natural sciences because they were weak in calculations but for the fact that they were more interested in human behaviour rather than machines or instruments and also had plans to make social work their future careers.

Participants, according to the findings, choose to study the natural sciences out of influences from their parents who they saw and still see as role models. Some students also cited factors like family, career prospects and prestige as motivations for their choice of the natural sciences for study at high school. These students generally see science as more challenging as opposed to being difficult and infact they believe the difficulty is negligible when they take the future returns into consideration. Specifically, unlike physics, subjects like biology and chemistry are regarded by the students as complementary subjects with lots of similarities that make them easy to grasp. In addition students consider physics as a difficult subject on the premise that it is always dominated by calculations but that hardly bothers them.

Participants in both groups shared similar views that the contents of science subjects are formalistic and in most cases have to be accepted without questioning or proving which leads to a lot of memorizing which most students cannot handle. For the natural science group they have a problem in that they cannot properly understand what they are taught but had to memorize just to pass in examinations as indicated in subsection 5.3.3.

Since mathematics' ubiquity in the natural sciences cannot be doubted the question of the students' prowess in mathematics came up. Findings indicated that the non-natural science students were naturally weak in mathematics or calculations whereas it is the converse for the natural science students. The natural science students work hard to improve or excel in mathematics since it is the key to their academic success and career prospects. Ironically most of the students in the natural science group dislike mathematics but were good in it and had to upkeep their competences because it is being ubiquitous in their areas of interest.

Finally, some natural science students confessed they would like to go into business someday but made it categorically clear that that is not their motivation to study science and most would like to own science-related firms in the future. As for the students in non-natural science group none was thinking about future business endeavours.

So if comparisons are made between the two approaches it is without question that all the reasons leading to choosing or not choosing to study the natural sciences are same irrespective of contexts. There is also a strong showing or presence of social values in the findings from all two approaches which is in full support of the answer to the research question. But taking the different societies into consideration the researcher cannot ascertain or pinpoint the social values of a particular European society and had to rely on literature information as well as generalised sociological information and that is where those identified in this study come in.

Finally, we can see that there is a lot of motivation to study or not study science which stem from the umpteen reasons already stated. Though it has been earlier mentioned that data conformity with the

two theoretical frameworks is not within the scope of this work, there is enough reason to make mention of the behavioural and goal intentions of the students with respect to their responses.
The non-science students as we have seen have a lot of shortcomings and negative beliefs about mathematics and science which made them unfit for studying the natural sciences though some had the intention. With such attitude their goal intentions were geared towards becoming non-science or non-technology professionals whereas their behavioural intentions remained choosing to study other than natural science-related subjects. In the case of the natural science students, though some were having a forced motivation, their goal intention was about becoming doctors, engineers, chemists or other science-related professionals while in their behavioural intention they choose to study the natural sciences being influenced or driven by certain values. From the given observations, we can see the data from this interview which reflects the students' behaviours, agree with both the TRA and the GT.

Chapter 7

CONCLUSION

7.1 Overall conclusions

The investigation has clearly shown that social values indeed have an impact on students' choice of the sciences. We can see that most of the respondents choose to study the sciences after being motivated by the family,money, well-paid jobs, prestige and higher social statuses. Though social values may vary from society to society what is of prime importance is that most of the students' motivations stem from these values. Actually research centering on social values in connection with students' choice of science has not been done as far as the knowledge of this researcher goes. All that has been done as seen from the literature review was motivational and attitudinal factors other than social values and issues they are associated with.

Are students in Sweden really motivated by social values? From observations during the interviews as well as the interactive discussions some students have at least a parent whose profession is science-related and would like to follow such footsteps which underpins the notion that students' motivations or attitudes towards science can be influenced by their family(5.3.2). In the other instances we have discovered is the influence of the rewards which they stand to reap if they become science-related professionals. Some of the students accepted they choose to study the natural sciences because their statuses will be elevated in the society and also because they expect to get good salaries. We can see that the values of the society have resulted to some participants favouring the natural sciences which culminates in the intention to become science-related professionals. By studying the natural sciences which is a behaviour they have set their goals to becoming doctors, engineers, scientists etc. as proposed by the TRA and GT.

Moreover from this study we can assume that a behavioural intention can be predicted provided the right attitude is instilled and that goals do influence a student's intrinsic motivation to learn. We can also assume that goal intentions can influence and govern behavioural intentions as seen in the previous paragraph. Drawing from the data most students who study the natural sciences had personal goals or goals set out directly or indirectly by their families or the society they live in which in turn are driven by attitudes and intentions. The goals provide the motivation; they are the vehicle that propels them to their science-prone aspirations. If we go by these assumptions we can state that even though the TRA and GT have been last used in a study many years ago the findings from this study somehow confirms the two theories to a large extent.

Though the subjects of this work are students, it will not be wrong to include the teachers since they are also part of the teaching and learning processes.. Taking a cue from the data especially the interviews, the attitudes of the teachers followed by their teaching methods need to be reviewed. It is disheartening to learn from the participants that some of them would have loved to study the natural sciences had it not been for the teachers and their ways of delivering the contents of the topics they treated. Some students intimated that from their observations, the teachers were interested in developing their cognition but surprisingly could not do so because of some inhibitions.

According to the participants all the teachers do is just go through what they have prepared for the particular lesson and while doing so made sure that no student becomes a hindrance by asking

questions or repetitions of explanations which projects the lessons as more teacher-centered. These views were equally shared by participants from both groups. While the teachers have their own share of the blame, the bureaucracy too should not be spared. According to a BBC news article, most of the teachers in Sweden are disgruntled and demoralised due to low salaries that follow after a lengthy training and heavy workloads. Infact teachers are paid lesser than any other graduate professional(http://www.bbc.com/news/education-33115771).

But inspite of all the constraints they are facing, students still opt to study the natural sciences because they want to reach the self-actualization level of Maslow's hierarchy. This stems from the positive attitudes towards science instilled in them by the values of their societies which further leads them to their goal and behavioural intentions. Bent on pursuing their goals, these students are motivated to learn the natural sciences under any circumstances..

7.2 Recommendations for further research

The research conducted for this dissertation has highlighted some areas on which further research will be required because it will be of benefit. Most of these areas have been revealed in the data and while some have been addressed, some still remain unaddressed.

- The teachers' problems in particular need to be addressed if an improvement in students' motivation is of prime concern.

- Social values are treated holistically in this work but what the researcher did not delve on is the different values for different countries or regions. Time and scope did not permit the researcher to figure out what people in specific countries or regions in Europe value most in terms of motivation to learn science. This should be a significant food for thought.

- From the findings of this work a social value concept can be used to foster the study of the natural sciences by youths and should made more socially and academically prominent or conspicuous.

Finally this work can be a trailblazer or a curtain-raiser of the researched area which still needs to be explored. There might other researchers with different approaches and available resources who might intend to go beyond the limitations of this work in terms of participants and contexts as well as the recommendations stated above, so there is still room for further research.

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APPENDIX A
Systematic literature review

TITLE	N=	METHODS	FINDINGS	YEAR	PUBLISHER/ JOURNAL
Staying in Science Science -Hipkins and Bolstad	UA	Qualitative: Literature Study (Comparative study between Australia and New Zealand	There is still a great deal of we don't know about students' decision-making related to choosing science. However it is important to note that contextual factors such as family background have a clear impact. But what is clear is that there is no single way to account for choice patterns. Also students have different reasons, circumstances backed by their dispositions, interest future plans and choice-making experiences.	2005	*New Zealand Council for Educational Research*
How choosing science depends on students' individual fit to science culture -Taconis and Kessels	541	Quantitative: Survey	The way typical peers who favour science are perceived can be linked to a specific culture of science that involves a certain way of being and possesses specific personality traits. Peers who favour science subjects are perceived as less attractive, less attractive, less popular and socially competent, less creative and emotional, and more intelligent and motivated than typical peers who favour humanities subjects.	2009	*International Journal of Science Education*
Attitudes towards science: A review of the literature and its implications - Osborne et al.	UA	Qualitative: Literature Study	Factors influencing students' attitudes include gender, personality, structural variables and curriculum variables. Girls have less positive attitudes as compared to boys.	2010	*International Journal of Science Education*
Puplis' attitudes toward natural sciences and the decision-making process when selecting a field of study at university -Topinka et al.	1173	Mixed: Quantitative-Survey Qualitative-Focused groups	Pupils or students consider natural sciences to be interesting, yet not well-liked. The responses in the quantitative data demonstrate that their attitudes towards science are positive. They attribute intelligence and diligence to scientists and perceive them as insociable and unkempt or shabby in appearance which is fairly stereotypical. Scientists are also isolated from the outside world and are confined within the walls of the laboratory in which they practice.	2008	*Problems of Education in the 21st Century*

			Pupils or students see science through three important participants: laymen, students and scientists. On one extreme are the laymen or the ordinary people, on the other is the scientist. The first is a consumer of what the second one produces while the student finds himself midway between the two.		
Brain type, sex differences and motivation to learn science: A cross-cultural study -Zeyer et al.	1300 (Upper secondary school students)	Quantitative: Survey	The motivation to learn science is directly and strongly influenced by the systemizing quotient and indirectly and very weakly by sex. The more someone systemizes the greater their motivation to learn science will be. The findings also suggest that successfully improving the systemizing dimension of the low systemizing quotient students' cognitive style could consequently lead to improvements in their engagement in science.	2011	*European Science Education Research Association*
Physics: Frightful, But Fun Pupils' and Teachers' Views of Physics and Physics Teaching -Angell et al.	2534 (Consisting of teachers and upper secondary school pupils)	Mixed: Quantitative-Survey Qualitative-Focused groups study	Pupils find physics interesting but difficult and intensively laborious; formalistic in nature but still describing the world and everyday phenomena. Pupils express that "exotic" topics like astrophysics are closer to their life-world than mechanics etc. Whereas teachers complain about pupils' poor mathematics skills, pupils do not see this as a major problem. Physics instruction is still dominated by traditional content knowledge and seems to attract and reward pupils with this orientation. Pupils have a relatively weak understanding of the central role of experiments in science. Furthermore, pupils would like stronger emphasis on qualitative and pupil-centred approaches in teaching and learning.	2004	*Wiley Periodicals: WileyInterScience (www.interscience.wiley.com)*
Choosing Science at 16: The Influence of Science Teachers and Career	155 (between the ages of 9 and 11)	Mixed: Survey and Case Study	Science was usually enjoyed by pupils up to year nine in the schools involved in the case study. Few regretted having to study science up to the end. Pupils who had plans to discontinue	2000	*National Institute for Careers Education and Counselling*

Advisers on Students' Decisions about Science Subjects and Science and Technology Careers. -Munro and Elsom			their study of science made up their minds by the end of year ten based on their experience of science in the classroom. On the other hand those who planned to stay were either keen on the subject or in some cases had found out about a particular career that had caught their interest and for which they knew they needed science. In a nutshell pupils more or less need reasons for studying science.		*Carrers Research and Advisory Council*
Choosing Science: Understanding the declines in senior high school science enrolments -Lyons and Quinn	589 teachers and 3759 students	Quantitative: Survey	The study found that declines in the proportions of students taking physics, chemistry and biology are part of a broader phenomenon which has seen similar falls in many traditional subject areas. Declines in science enrolments are *most likely* due to an interrelated set of factors centred on the changing context of subject choice for senior high school. The principal factor appears to be students' responses to the greater array of options available in Year 11, resulting in proportionally lower enrolments in many long-standing subjects. The context of greater choice has also heightened the influence of three contributing factors more closely associated with science education: • the difficulty many students have in picturing themselves as scientists; • the decrease in the utility value of key science subjects relative to their difficulty; and • the failure of school science to engage a wider range of students.	2010	*National Centre of Science, ICT and Mathematics Education for Rural and Regional Australia (SiMERR Australia)* *www.asta.edu.au and www.une.edu.au/simerr*
Science Education in Europe: Critical Reflections -Osborne and Dillon	UA	Mixed:Survey, Reflections	Answers to the question about how we can engage young people with school science are complex but research and scholarship would suggest that the lack of engagement is a mix of: ■ A lack of perceived relevance. School science is often presented as a set of stepping-stones across the scientific landscape and lacks sufficient	2008 A report to the Nuffeld Foundation	

			exemplars that illustrate the application of science to the contemporary world that surrounds the young person. An oft-quoted example is the inclusion in science lessons of the blast furnace and the Haber process, both of which do not relate easily to what has been christened the 'iPod generation'. A pedagogy that lacks variety. ■ A less engaging quality of teaching in comparison to other school subjects [14]. ■ Content which is too male-orientated[15]. ■ An assessment system that encourages rote and performance learning rather than mastery learning for understanding.		
Students' reflections on choosing to study science post-16 -Pike and Dunne	80 students	Qualitative:Focused group interviews and Discussions	For the student respondents in this research, pedagogy, a discourse of differentiation in science and the student educational and occupation futures in a dynamic and changing post-16 and labour market are all invoked as having a significant bearing on the choices that students make about their studies in the post-compulsory sector. In effect, the student sample suggests that science would be more appealing if it were more weakly framed with less teacher authority, more discussion-based learning and greater relevance to the everyday. It has become clear that pedagogies of the secondary science classroom and the discourses that are bound up within it, have a major influence on students' learner identities, their identification with science and their choice of whether or not the study of science should be a part of their future education.	2010	*Cultural Studies of Science Education*

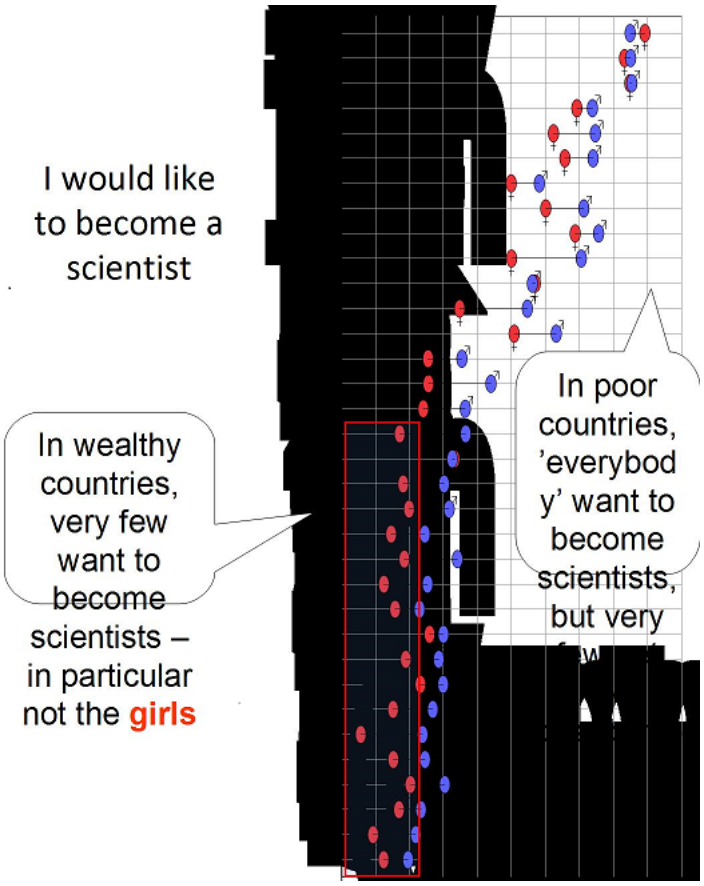
Students' view of science: A comparison between tertiary and secondary school students -Ghali Hassan	40 students	Qualitative:Interviews	One of the key findings of the study was that students' views of science were positive. Students' personal responses show that the majority of of students in both groups viewed science favourably. Generally and regardless of their grade or level, majority of the students view science positively and see their interest in and enjoyment of science as the major motivational factors for studying science. Moreover, female students seemed to have more positive views of science than their male counterparts. Negative image of science seemed to be one of the most common factors contributing to students' avoidance of science. Some students had already made their final decisions and science was not part of their goals. The dominant views of science among the participants in the samples was that science is useful because it is inextricably linked to the well-being of humanity.However, students studying non-science subjects are not interested in science and believe that despite its usefulness to society, science is a different domain to master. And lastly secondary school students' view of science is less positive than that of the university students notably among males which can be due to individual experiences in science.	2011	*Science Educator*
The influence of teachers on students' decisions about choosing science: Comparing student and teacher perceptions - Lyons & Quinn	3759 (Students) and 589 (Teachers)	Quantitative: Survey	The study found that students considered their science teachers to have had the greatest influence, followed by parents and then friends. In contrast, however, science teachers believed their students to be most influenced in their decisions by friends and peers, followed by older students and siblings and parents, with teachers themselves having relatively little influence. Both groups believed that advice from careers advisors was of little influence.	2012	*Symposium of)the International Organization for Science and Technology Education*
Why Students Choose STEM Majors: Motivation, High	12,500 Students	Quantitative:Survey	Results suggest that choosing a STEM major is directly influenced by intent to major in	2013	*American Educational Research Association and*

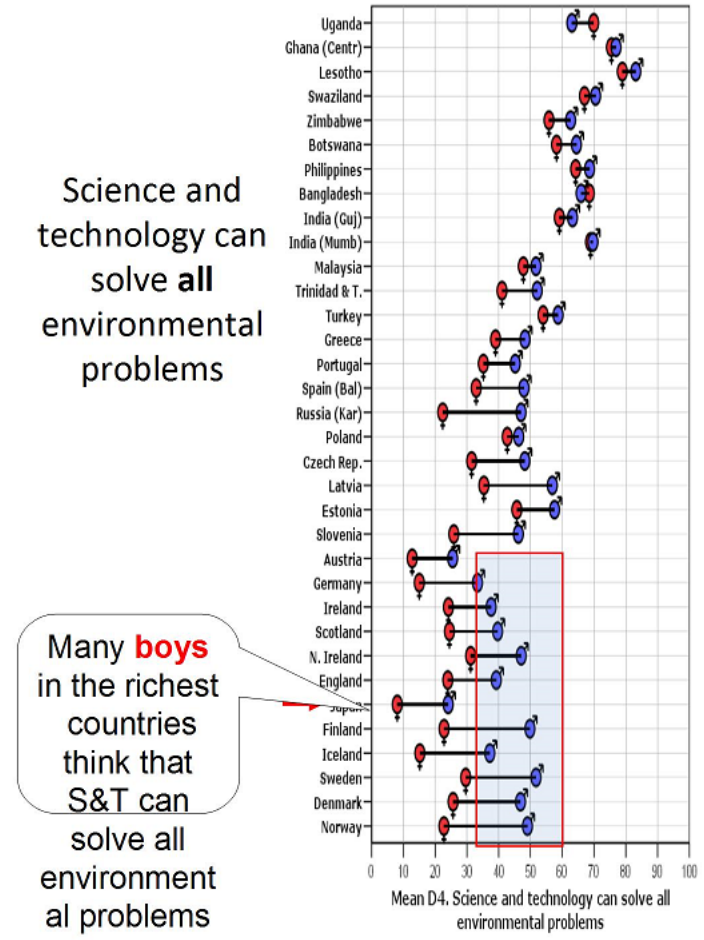
School Learning, and Postsecondary Context of Support -Xueli Wang			STEM, high school math achievement, and initial postsecondary experiences, such as academic interaction and financial aid receipt. Exerting the largest impact on STEM entrance, intent to major in STEM is directly affected by 12th-grade math achievement, exposure to math and science courses, and math self-efficacy beliefs—all three subject to the influence of early achievement in and attitudes toward math. Multiple-group structural equation modeling analyses indicated heterogeneous effects of math achievement and exposure to math and science across racial groups, with their positive impact on STEM intent accruing most to White students and least to underrepresented minority students.		*SAGE*
Different Countries, Same Science Classes: Students' experiences of school science in their own words -Terry Lyons	UA	Qualitative:Literature Study	Despite their different national contexts, the most prominent issues in each case revolved around the same three themes. The first of these relates to the transmissive pedagogy of school science, a feature reported so widely that students appeared to regard it as an inherent characteristic. The second theme concerns the personal irrelevance of much of the curriculum content, which Osborne and Collins found to be "a recurring theme" among students regardless of whether they intended to continue with science study (2001, p. 449). This criticism was the most frequently expressed among Lyons' students, and the first point addressed in Lindahl's summary of her students' attitudes. The third theme is the perceived difficulty of school science; the most salient consideration for students deciding about taking further science courses.	2007	*Taylor and Francis*

How can we motivate high school students to study science? -Rachel Mamlok-Naaman	90 Students 3 Teachers	Mixed: Quantitative-Survey Qualitative-Interviews	It was shown that the most effective factor contributing to students' decision to study science was their interest in the subject. Despite the fact that 10th grade students studied science for three years in junior high school, many of them were unfamiliar with basic concepts that appeared in the science syllabus. The degree of interest shown by students in a given subject was greater when they were familiar with the subject and thus wished to hear and know more about it. Therefore, students' exposure to various scientific subjects can be expected to induce them to show more interest, arouse their curiosity and enhance their desire to know more.	2011	*International Council of Associations for Science Education*
Participation in Science and Technology: Young people's achievement-related choices in late modern societies -Bøe et al	UA	Literature Study	This article's review of research literature, has presented evidence that young people's interest in school science and mathematics is relatively low, and tends to decline as they progress through school. The subjects are often characterised as having transmissive pedagogy, and unengaging, decontextualised content. For science, however, the disenchantment is greatest with *school* science. Students often show more interest in science topics *per se*. Students also regard science and mathematics as important in general, but less so for them personally. They struggle to identify with STEM culture and with STEM professionals, and often find them ill suited to their identity. Many students tend to choose post-compulsory STEM subjects for instrumental reasons: for example to gain admission to a preferred university or keep their options open. Promises of a good job market and high salaries also motivate STEM choice, but STEM subjects and studies do not appear to offer the easiest paths	2011	*Studies in Science Education (Taylor and Francis)*

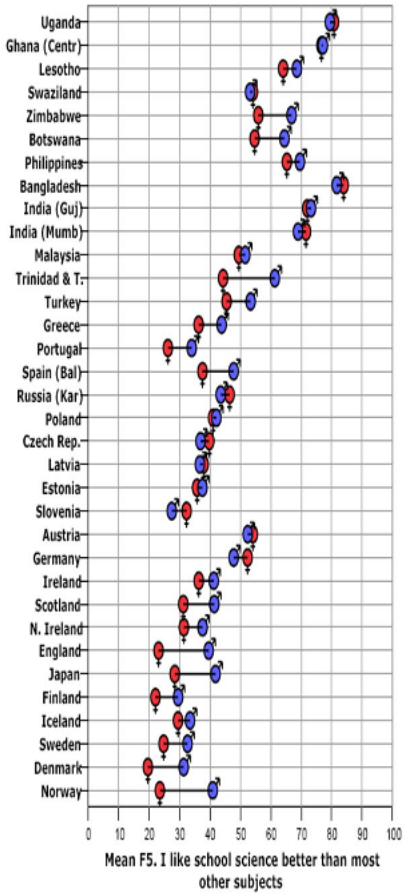
			to money and job security due to their reputation as costly in terms of difficulty and work load. This perception of difficulty also affects students' expectation of success in these subjects,which is generally lower than their expectation of success in other school subjects. Girls tend to have lower expectation of success and perceive a higher cost associated with studying science and mathematics. They identify less closely than boys with the disciplines and the professionals associated with these subjects and have different interests and different expectations for their understanding within the subjects. Finally, girls are less inclined to regard STEM as a means of attaining extrinsic goals and expectations than are boys.		

APPENDIX B
The ROSE graphs used in the interactive discussion





I like school science better than most of the subjects



School science has shown me the importance of science for our way of living.