MOTIVATION TO LEARN SCIENCE AMONG SECONDARY STUDENTS

A comparative study between Sri Lanka and Norway

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Abstract

This study is a comparative study between Sri Lankan and Norwegian secondary level students with regards to their motivation in science learning. Self Determination theory (SDT) (Deci & Ryan, 2000) has been used as the theoretical framework and the study has been designed as a deductive study. Mixed methods research strategy has been adopted to meet the requirements set by the research questions. The study revolves around two research questions. The first research question focuses on identifying the level of motivation for science learning among Sri Lankan and Norwegian secondary school students. It has another sub question which studies whether there is a correlation between gender and motivation in the two countries. The second research question is an exploration of the level of basic psychological needs satisfaction among Sri Lankan and Norwegian students. The research instrument employed in the quantitative component of the study was Academic Self-regulation questionnaire (SRQ-A) developed by SDT theorists. The original questionnaire was slightly modified to suit science learning and an additional section was included in to the questionnaire to gather supplementary data regarding socio-economical variables. A total of 145 10^{th} grade students (n=145) from each country answered the questionnaire which was translated in to their mother-tongue. For the qualitative component data collection was carried out via semi-structured interviews. Six students and two teachers from each country participated in qualitative interviews. It was revealed that both Sri Lankan and Norwegian students are extrinsically motivated to learn science. However, the most prevalent regulatory style is identified regulation which is the most internalized form of motivation measured by SRQ-A. There was no statistically significant difference between the Sri Lankan and Norwegian RAI value ($p>0.05$). It was found that there is no correlation between gender and motivation in the two country samples. In terms of basic psychological need satisfaction, Norwegian students are ahead of Sri Lankan students. It was concluded that the pedagogical and socio-cultural differences between the two countries lead to this difference.

***Key words*:** Self-Determination Theory, science learning, Norway, Sri Lanka, Academic self-regulation, Motivation

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Abbreviations

BPNT	Basic Psychological Needs Theory
CET	Cognitive Evaluation Theory
COT	Causality Orientations Theory
GCE A/L	General Certificate of Education (Advanced Level)
GCE O/L	General Certificate of Education (Ordinary Level)
GCOS	General Causality Orientations Scale
GCT	Goal Contents Theory
OECD	The Organization for Economic Co-operation and Development
OIT	Organismic Integration Theory
PISA	Programme For International Student Assessment
PLOC	Perceived Locus of Causality
RAI	Relative Autonomy Index
RMT	Relationships Motivation Theory
SDT	Self-Determination Theory
SRQ-A	Self-Regulation Questionnaire (Academic)
TVET	Technical and Vocational Education and Training
UNESCO	United Nations Educational Scientific and Cultural Organization

1 Introduction

1.1 Background

In an era where global discussions about a fourth industrial revolution are slowly propagating in the scientific community, to keep in pace with these massive scientific and technological advancements that occur at exponential rate, a highly competent scientifically-literate human resource has become vital to any country. Consequently, science, technology, engineering and mathematics (STEM) subjects have strategically moved up in the education agendas of all developed and developing nations alike. Satisfying the demand for high and mid level skilled science professionals greatly relies upon the capacity of the school science education system of a country to motivate the young learners to become future science professionals.

In the science education literature school related constructs such as motivation, attitudes, academic achievement, academic engagement have been extensively studied (Black & Deci, 2000). It is evident that there is a strong relation between motivation, positive attitudes, engagement in academic work and success in mathematics and science (Singh, Granville & Dika 2002). Numerous studies have shown that students' motivation to learn science decline when they go to upper grades (Yasushi, 2009; Vedder-Weiss & Fortus 2011). Human beings are inherently inquisitive in nature and when students first learn science in their primary school they all have high interest and inquisitiveness towards science. In general all students enjoy their first steps in science which starts in most curricula by initially exposing students to the environment. It is necessary to nurture the interest to learn science so that students become intrinsically motivated to learn science. This is a challenge faced by science teachers all around the world. Intrinsic learning is regarded as superior to extrinsic learning (Deci & Ryan, 1985).

"To be motivated means to be moved to do something. A person who feels no impetus or inspiration to act is thus characterized as unmotivated, whereas someone who is energized or activated toward an end is considered motivated" (Ryan & Deci, 2000, p.54). Etymologically "motivation" has derived from the Latin word *Movere* which means to move. From the early days of civilization, people have been curious to understand why individuals do certain tasks. Motivation is a massively studied construct and the related theories belong to different schools of psychology. The main schools of psychology are psychoanalyst, behaviourist,

cognitivist, psychobiologist and humanist. The fundamental division between these approaches is based on the assumptions each approach make about humans. The methodologies employed in each approach are intertwined with the basic assumptions (Deci, 1975).

The many different approaches to the study of motivation can be broadly viewed as either mechanistic or organismic approaches. Mechanistic approach endorses that human beings are passive and their behaviour is triggered by physiological drives and environmental stimuli. They believe satisfaction of tissue needs generated by the central nervous system is the primary drive for motivation. For instance, behaviourists are concerned with the associations between stimuli and responses (S-R psychology) and radical behaviourists like B.F.Skinner completely overlooked the inner processes (Deci, 1975). In contrary, organismic approach embraces the assumption that human beings are active, volitional and are capable of initiating their own behaviour. Cognitive, affective and humanistic psychologists base their theory and research on organismic approach.

Edward Deci and Richard M. Ryan coined Self-Determination Theory (SDT) which is purely an organismic theory. SDT lays the theoretical foundation of this research. SDT presents a broad framework to study human motivation and personality. It emphasizes the organization, unity and integration of human beings elaborating inherent human growth or developmental tendencies. SDT is an empirically derived macro theory which has been applied in different domains such as education, health care, religion, work, psychotherapy and sport (Ryan & Deci, 2000). Its application in the field of education aims to understand students' genuine interest for learning and accomplishment, how they internalize values and regulatory processes (Deci *et al*., 1991). In SDT perspective, an effective learner is one who is self-determined by satisfying his or her basic psychological needs (competence, autonomy and relatedness) and an effective classroom is one which fosters these basic psychological needs of the learners, thereby creating self-determined learners (Jarvis, 2005). This understanding can ultimately contribute to promote students' interest in learning, valuing of education and gaining confidence in their own capacities and attributes.

1.2 Rationale

This study is designed as a comparative study between Sri Lankan and Norwegian 10th grade students. With the researcher's hands-on experience as a science teacher in lower secondary and upper secondary levels in the Sri Lankan public and private schools, the research problem stems from an observation done by the researcher. It was observed that student motivation to learn science fluctuates drastically during secondary level, and the researcher is keen on investigating this empirically using an appropriate theory.

Motivation is a widely studied topic at international level but in the Sri Lankan context hardly any published research exists. A comparative study between two countries which are socio-culturally and economically contrasting brings in many challenges to the researcher. However, with globalizing forces more and more Asian countries participate in international comparative studies such as PISA (Programme for International Student Assessment).

Why grade 10?

One policy objective of the national science and technology policy in Sri Lanka is to foster a science, technology and innovation culture that effectively reaches all citizens of the country (National science and technology commission, 2008). The strategies to achieve this objective are to provide equal and adequate opportunities for all to acquire a basic science education and to encourage inquisitiveness and application of scientific methodologies for efficiency and productivity in everyday life (National science and technology commission, 2008).

"The GCE O/L science results in Sri Lanka have declined by 7 percent between 2002 and 2009" (World Bank, 2011). In analyzing the learning outcomes of science using GCE O/L science results from 2005-2008, achievement levels of both girls and boys show a positive trend and girls have performed marginally better (World Bank, 2011). The analysis of learning outcomes of students by sub-skill using 2005-2008 GCE O/L results illustrates that the strengths of students are still in comprehension, assimilating knowledge and analysis (World Bank, 2011). Students are still weaker in application and synthesis. In order to develop these higher order skills it is necessary to make the learner enthusiastic and curious about science to facilitate deep conceptual learning.

In order to enhance the inquisitiveness of the learner and develop critical thinking and application skills it is necessary to make science interesting for the learners. If not they will learn science superficially in a compartmentalized manner. By making science interesting the students will become self-regulated learners. The level of motivation, attitudes of students toward science, engagement in science are helpful indicators to ascertain whether the science education is on the intended path. It is in grade 10 that the science syllabus starts expanding in depth and breadth and divides in to chemistry, physics and biology. Understanding the level of motivation and self-regulatory patterns of 10^{th} graders to learn science would be an ideal indicator to see whether they learn science out of genuine interest or due to external contingencies; in scientific terminologies whether they adsorb or absorb science.

Why lower secondary education?

Lower secondary education is one of the most important segments of the Norwegian education system as the end of lower secondary education marks the end of ten year compulsory education. It is shown that by enhancing the quality of lower secondary education the overall attainment and prevention of dropout is achievable (OECD, 2011). Moreover, the significance of lower secondary education is emphasized as it is the period which lays the foundation for key subjects which is necessary in future either for higher studies or in the labour market (OECD, 2011). Therefore there is a great concern about the level of motivation for learning and performance in this age group. Even international comparative studies like PISA are conducted on 15 year old students.

Norway takes part in PISA and over the years Norwegian students have not been performing satisfactorily in these tests (Figure 1.1). Norway's average has been below the OECD average which has raised concerns about science education in Norway. Therefore studying the level of motivation for science among 10^{th} graders is of significance in the Norwegian context as well.

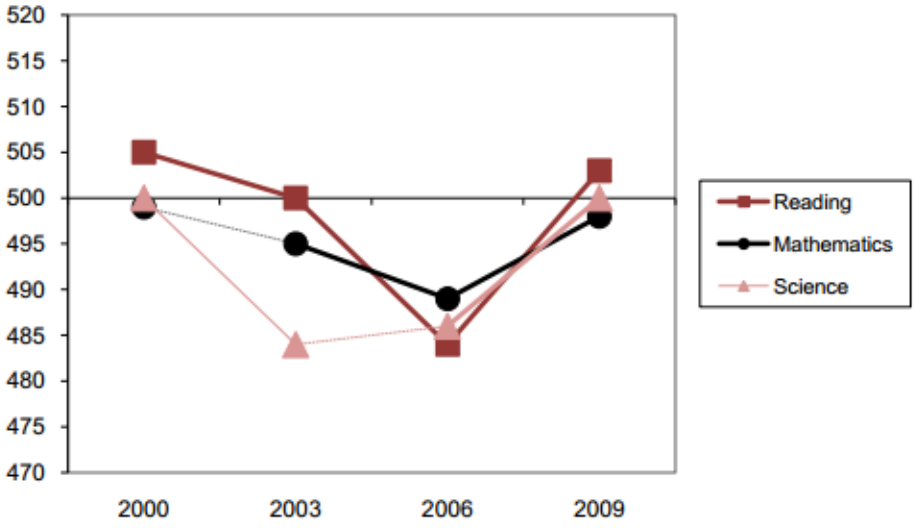


Figure 1.1 Norwegian results in PISA for the four assessments for each of the subject areas. The margin of error in each data point is around 5 points. In addition, the framework in mathematics and science literacy has been altered, and thus the scales are not quite the same. Comparisons that are especially problematic appear as broken lines.

Source: Kjærnsli, M., Roe, A., (Eds) On the right track: Norwegian Students' proficiency in Reading, Mathematics and Science Literacy in the PISA Assessment 2009

1.3 Purpose of the study

The purpose of the study is to measure the level of motivation of Sri Lankan and Norwegian 10th grade students' to learn science. The study will explore the motivational patterns and the self-regulatory patterns of the learners. In addition, students' basic psychological need satisfaction will be studied.

1.4 Research questions

In order to achieve the abovementioned purpose of this study the following research questions are formulated.

1) What is the motivation pattern for science learning among Sri Lankan and Norwegian 10^{th} graders, as measured by SRQ-A?

    - Is there a correlation between gender and motivation concerning the Sri Lankan and Norwegian samples?

2) How do the Sri Lankan and Norwegian student perceptions about science learning reflect their basic psychological need satisfaction?

1.5 Structure of the thesis

The thesis is presented in seven chapters. The first chapter unfolds the background of the research and it is a point of departure to the theoretical framework. It describes the research problem, purpose of the study and research questions. Chapter 2 is a presentation of the contextual background of the two countries. Considering the significance of thorough understanding of the main theoretical aspects of SDT to enable deeper exploration of the research problem, chapter 3 presents a comprehensive presentation of the theory with an underpinning review of relevant literature. Chapter 4 presents the methodological approach employed in this study. It describes the research design, research strategy, research instruments and sampling techniques. The fifth chapter is a presentation of results. It analyses the data collected from both quantitative and qualitative studies and discuss the results in light of SDT. Chapter 6 presents conclusions of the study. Chapter seven concerns limitations of the study and future directions. It will describe future directions which would be recommendations for a similar study to overcome the limitations encountered by the present study.

2 Contextual background

The three basic psychological needs of SDT can be satisfied or thwarted only when an individual interacts with his or her social environment. Thus motivation cannot be studied in a decontextualized manner. A thorough study of motivation requires an adequate understanding of the context. This chapter is an attempt to portray the relevant contextual pictures of Sri Lanka and Norway which would facilitate the reader to conduct meaningful comparisons. A brief country profile will be provided for each country following an overview of each education system in general and then science education in particular.

2.1 Country profiles

2.1.1 Sri Lanka

Sri Lanka is a developing country situated in the South Asian region with a population of 20.77 million (Table 2.1). The ethnic composition of the population is Sinhalese 74.9%, Sri Lankan Tamils 11.2%, Indian Tamils 4.1%, Moor 9.3%, Burgher 0.2% and Maley 0.2% (Department of census and statistics, 2015). The religious affiliations of the population are Buddhists 70.1%, Hindus 12.6%, Islamists 9.7%, Roman Catholics 6.2% Christians 1.4% (Department of census and statistics, 2015). Sri Lanka has been under the colonial occupation for centuries; Portuguese, Dutch and the British ruled Sri Lanka successively and the latter had a significant impact in shaping the education system of the country. Sri Lanka had a traditional agrarian based economy which transformed to tea, rubber and coconut exporting economy. Following the implementation of the economic liberalization policies in 1977, the country's economy shifted to an open economy which is now predominantly service based. Sri Lanka has the highest literacy rate in the South Asian region (91.2% in 2010) owing to the free education system established in 1945. Sri Lanka being a welfare state provides free education from grade 1 until the completion of the first degree at state universities.

Public education financed by the state form the backbone of education in both countries despite the prevalence of private education at all primary, secondary and tertiary levels. Government schools in Sri Lanka are basically divided into two categories as national schools and provincial schools depending on the governance. National schools are directly governed by the ministry of education and they possess more resources compared to provincial schools

governed by the provincial education ministries. The nine provinces in Sri Lanka i.e. Western, Central, Sabaragamuwa, Uva, Southern, Northern, North Central, North Western and Eastern (Figure 2.1) are divided in to education zones decentralizing the administrative powers. The Western province which is the research site of this research is divided in to eleven education zones namely, Colombo, Homagama, Sri Jayewardenepura, Piliyandala, Gampaha, Kaluthara, Minuwangoda, Kelaniya, Negambo, Mathugama and Horana (Ministry of Education).

In Sri Lanka at the end of primary education students sit for the grade 5 Scholarship examination through which the high achievers from around the island get the privilege to enter popular schools in the cities. Secondary education comprises of junior secondary education and senior secondary education. Junior secondary education lasts for 4 years until Grade 9 and that marks the end of compulsory education. Senior secondary education continues for two years and at the end of grade 11, students sit for the General Certificate of Education Ordinary level (GCE O/L) examination. After GCE O/Ls students either start collegiate level (2 years) or can enter a technical college for one to two years technical education and obtain a vocational diploma. At the end of collegiate level, students sit for GCE Advanced Level (A/L) examination which is the university entrance examination. Currently there are science, arts, commerce and technical subject streams for A/Ls. After completing collegiate level, students can continue tertiary education by entering universities, National colleges of education (3 year teacher education diploma) or TVET institutes. A university first degree is of three to four year duration, a Masters degree is of two year duration and a doctoral degree is of three to five year duration (UNESCO, 2011).

Figure 2.1 Map of Sri Lanka

Source: Maps of world, Political map of Sri Lanka

http://www.mapsofworld.com/sri-lanka/sri-lanka-political-map.html

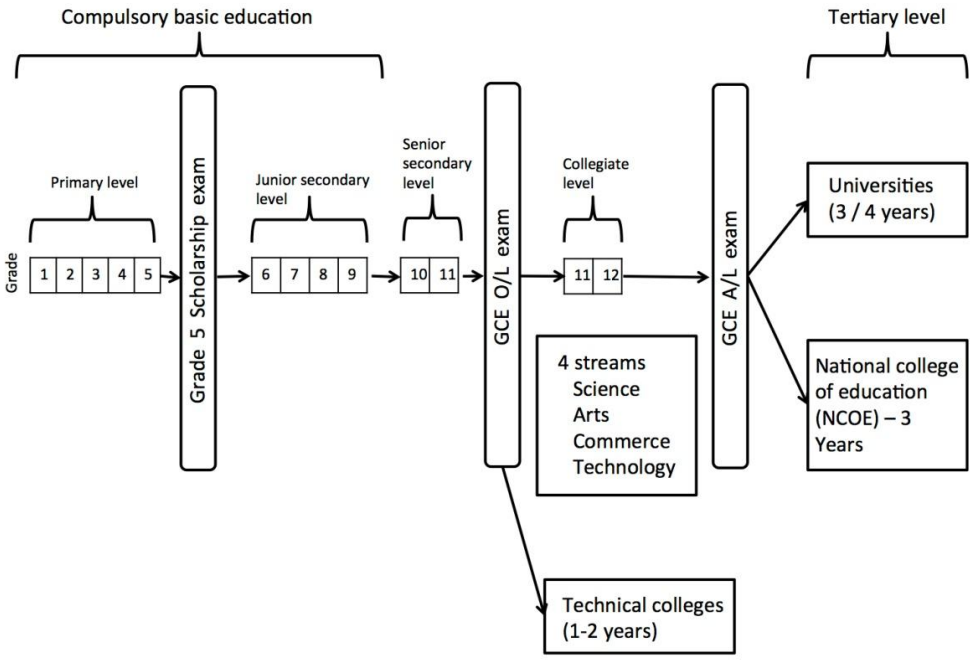


Figure 2.2 Sri Lankan school education system

Source: UNESCO (2011)

Science education in Sri Lanka

In Sri Lanka there is significant centralization with respect to school curricula, pedagogies and text books. These are set at the national level and there is less autonomy for teachers for any deviations. In Sri Lanka science is a compulsory subject until grade 11 and all students must compulsorily sit for science at the G.C.E. (O/L). In the primary grades it is taught as Environment education i.e. Environmental Related Activities and from grade 6 onwards the subject is named as science. From grade 10 the science syllabus is divided in to chemistry, physics and biology. Nevertheless the integrity in science subject is maintained in evaluation and assessment processes thus students receive only one question paper for science in the GCE O/L exam.

Overview of the grade 10 science syllabus in Sri Lanka

The three competencies that guide the grade 10 Chemistry syllabus are as follows.

- Inquires scientific discoveries regarding the structure and the quantity of matter
- Inquires periodic patterns in the properties of elements
- Uses chemical changes appropriately to fulfill life pursuits

(National Institute of Education, Sri Lanka)

The competencies that guide the grade 10 physics syllabus are,

- Uses relations of force and straight line motion to fulfill needs in life pursuits
- Investigates how thrust is exerted on objects by fluids
- Uses mechanical energy in day-to-day pursuits
- Uses methods of measuring transference of thermal energy
- Uses phenomena and principles related to electricity in day-to-day life
  (National Institute of Education, Sri Lanka, http://www.nie.sch.lk/ebook/e10syl19.pdf)

The competencies that guide the grade 10 biology syllabus are,

- Uses standard methods in the classification and nomenclature of organisms
- Investigates the level of organization in organisms
- Investigates the major biological processes in organisms
- Involves oneself in the prevention of diseases related to main systems in the human body
  (National Institute of Education, Sri Lanka, http://www.nie.sch.lk/ebook/e10syl17.pdf)

In Sri Lanka traditionally teacher-centered pedagogy was practiced for a very long span of time where the teachers performed the transmission role of teaching. It was more controlling oriented than autonomy supportive and the learners were passive absorbers of subject matter. Due to the vast competition in the education system in Sri Lanka which was a result of the limited educational opportunities available in the country, especially in higher education, both students and teachers had no other alternative but to be examination oriented. Consequently, the teaching-learning process created fewer opportunities for developing students' critical thinking and analytical skills and rote learning got deeply rooted in the system. Nevertheless in 1997, a package of educational reforms were introduced and implemented in the general education system which was indeed a paradigm shift (Ginige, 2002). These reforms were radical and transformational in to a system in which teacher-centered pedagogy had deeply

rooted. A student-centered, activity oriented, competency based reforms were implemented where teachers had to play the role of facilitators. The student-centered pedagogy was implemented via 5E instructional model which consists of five phases, namely, Engagement, Exploration, Explanation, Elaboration and Evaluation. Student-centered pedagogy is based on the constructivist principles that learners construct new knowledge upon their existing knowledge by interacting with their surrounding (Mascolo, 2009; Kain, 2003).

In a classroom where teacher-centered pedagogy is practiced the teacher is more controlling in nature where he or she takes the lead role. Controlling teachers provide lesser opportunities for students to make their choices, be self-initiating therefore the students' need for autonomy is thwarted. A controlling teacher establishes an authoritarian style in the classroom and due to the lack of student-initiated activities the students' need to feel competent is not nurtured. In a context where teacher decides everything, the students have lesser opportunities to interact with others. Consequently their need to perceive related to the social environment is hindered. There are fewer opportunities to construct positive interpersonal relationships with their peers and the teacher. In contrast, in the student-centered classroom the student is an active learner who is given more opportunities to be self-initiating and volitional.

In the Sri Lankan teacher guides it is apparent that group work is over utilized as the Engagement step in the 5E model. Group work provides many benefits to the learner, in reality, when successfully operationalized it assists the learner satisfy all three basic psychological needs presented in SDT. When students engage in tasks willingly they perceive more competent in relation to the environment. In a context where the teacher is playing the role of a guider rather than a controller, the teacher has more opportunity to build up positive interpersonal relationships with students. On the other hand students perceive more related to their peers. Students' perceptions of competence also enhance in a context where they are provided with the freedom for exploration. Also, they feel more autonomous as they have control over their activities. Therefore, in a theoretical perspective, the present pedagogical model employed in Sri Lanka helps nurture the need for competence, autonomy and relatedness.

2.1.2 Norway

Kingdom of Norway is a developed country in the Northern Europe and it also belongs to Scandinavia (Figure 2.3). It is a sovereign and unitary monarchy. There are 19 counties and 430 municipalities. Norway has been under the Danish and Swedish rule for a long time and consequently there are significant Danish and Swedish influences on the Norwegian socio-cultural milieus particularly in education. Norway had a population of 5.14 million in 2014 (Table 2.1) which is approximately one fourth of the population in Sri Lanka. Today, Norway has significant ethnic and cultural diversity due to its immigration policy. Since it is home to many immigrants, foreign professionals and asylum seekers the population is growing rapidly. Norway is also a welfare state and it has a more comprehensive welfare system compared to Sri Lanka. Norway is economically very strong and stable unlike Sri Lanka and there is a massive discrepancy in government spending on secondary education between the two countries (Table 2.1).

Figure 2.3 Map of Norway

Source: Maps of world, Political map of Norway

http://www.questconnect.org/norway.htm

Table 2.1 Comparison of selected socio-economic indicators of development between Sri Lanka and Norway

Indicator	Sri Lanka	Norway
Population	20.77 million (2014)	5.137 million (2014)
Income level	Lower middle income	High income: OECD
GDP	US$ 78.82 billion (2014)	US$ 499.8 billion(2014)
GNI per capita, Atlas method (current US$)	US$ 3440 (2014)	US$ 103,620 (2014)
Life expectancy at birth, total (years)	75 (2014)	82 (2014)
Unemployment, total (% of total labor force) (modeled ILO estimate)	4.6 (2014)	3.4 (2014)
Government expenditure on education (% of GDP)	1.7 (2012)	7.4 (2012)
Government expenditure per secondary student (% of GDP per capita)	8.3 (2011)	25.8 (2011)
School enrollment, secondary (% gross)	99 (2011)	113 (2011)
School enrollment, secondary (% net)	85 (2011)	96 (2011)
Pupil-teacher ratio in lower secondary education (Headcount basis)*	16.5 (2012)	8.5 (2013)
Pupil-teacher ratio in primary education (Headcount basis)*	24.4 (2013)	9.0 (2013)

Sources: The World Bank, http://www.worldbank.org/en/country/srilanka
The World Bank, http://www.worldbank.org/en/country/norway
The World Bank, http://data.worldbank.org/indicator?display=default
UNESCO, * http://data.uis.unesco.org/

The Norwegian education system

In Norway schooling starts at the age of six and the primary schools (barneskole) have classes from grade 1 to 7 (Figure 2.4). Lower secondary schools (ungdomsskole) have classes from grade 8 to 10. Some schools have classes from grade 1 to 10. In 1997 the number of years of compulsory education in Norway was increased from nine to ten years (Ministry of Education

and Research, Norway). Therefore completion of lower secondary education marks the completion of 10 years of compulsory schooling.

In Norway there are nationally conducted tests at different grades to identify the students' academic needs. The national quality assessment system (NKVS) prescribes mapping tests (Kartleggings prøver), national tests (Nasjonale prøver) and national exams (grunnskole eksamen) at the secondary level. Each test bears a unique purpose. . The results of mapping tests and national tests are used by teachers to identify the academic needs of individual pupils. In Sri Lanka there are no such national level tests which aim at identifying individual pupil needs. All pupils in the 10^{th} grade sit for the lower secondary level national exam at the end of their compulsory schooling. Upon completion of education and training, a certificate for primary and lower secondary education (vitnemål for grunnskolen) will be issued.

The upper secondary schools (Videregående skole) are separate and students must enter these schools to receive upper secondary education. Once the three year upper secondary education is successfully completed, a certificate for upper secondary education and training (vitnemål for videregående opplæring) will be awarded which is required for university entrance (The Norwegian Directorate for Education and Training).

The school governance is decentralized in Norway and the degree of decentralization of governance is higher compared to Sri Lanka. Primary schools and lower secondary schools are governed by municipalities whereas counties act as the owners of upper secondary schools. Universities are governed by the state. Municipalities have more autonomy regarding teacher recruitments.

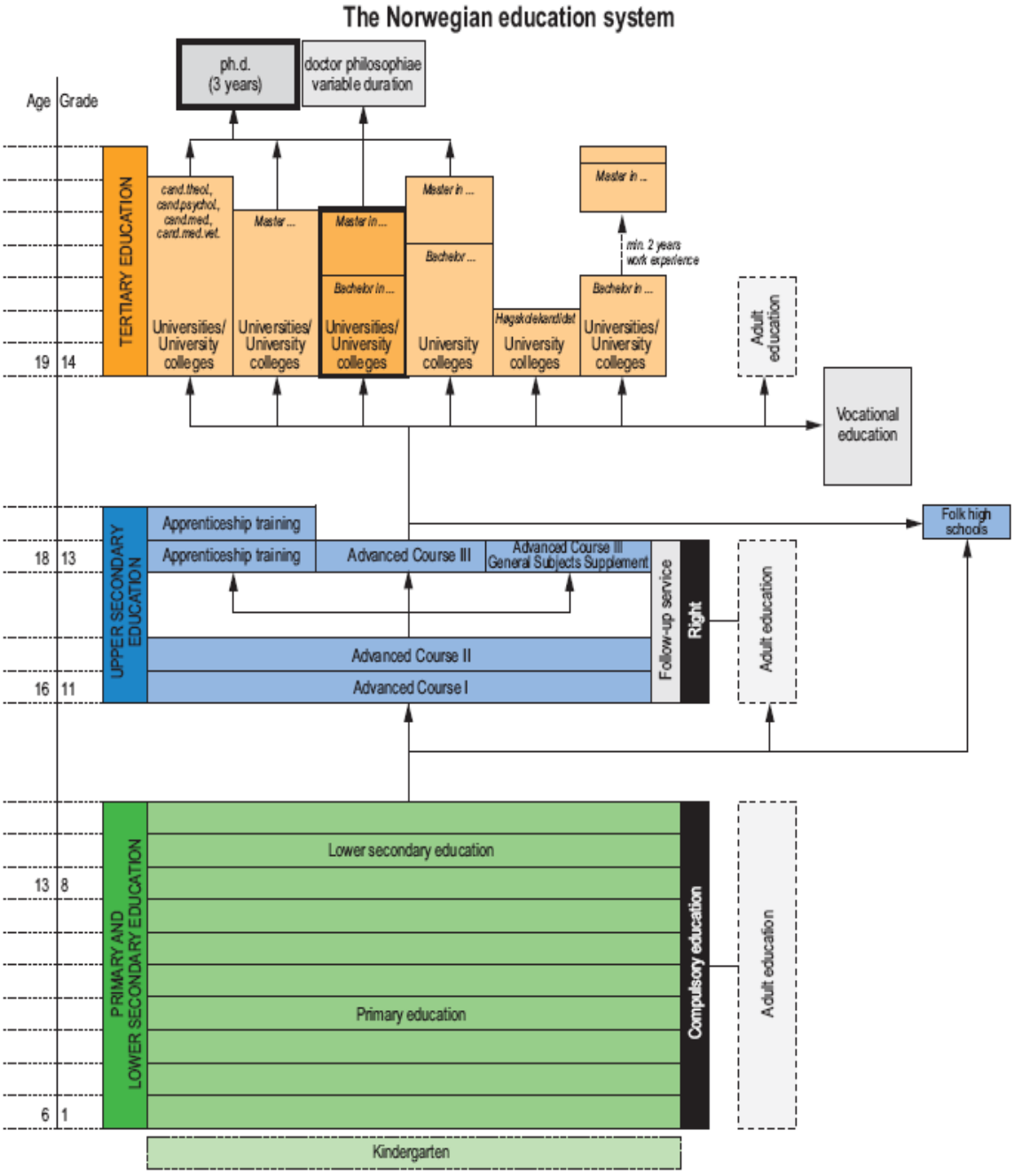


Figure 2.4 Norwegian education system

Source: Retrieved from http://www.ibe.unesco.org/fileadmin/user_upload/archive/Countries/WDE/2006/WESTERN_EUROPE/Norway/struc_nor.gif

Norwegian Grade 10 science curriculum

In Norway science is a compulsory subject from grade 1-11 similar to Sri Lanka. However, in contrast to Sri Lanka the syllabus is not divided in to chemistry, physics and biology and science is taught as general science in an integrated manner. The attempt is to make students learn science through day-to-day phenomena. In grade 12 and 13 students can make a choice as if they would continue learning science subjects or not. They can select chemistry, physics, biology, geology or technology and choosing the science stream implies that a student chooses any of these two subjects whereas few students choose three subjects (Osborne & Dillon, 2008).

In 2006 autumn the reform named "knowledge promotion" was introduced to the primary and secondary education and training in Norway and it is the latest reform in this sector. (Norwegian Ministry of Education and Research). "The (LK 06) national curriculum for knowledge promotion in primary and secondary education and training comprises: core curriculum, quality framework, subject curricula, distribution of teaching hours per subject, individual assessment" (The Norwegian Directorate for Education and Training). There are five basic skills that form the core of the curriculum. They are literacy, numeracy, ability to express orally, ability to express in writing and the ability to use digital tools. These basic skills are incorporated in to the subject curricula. This reform was an element of the national level strategic plan "A joint promotion of mathematics, science and technology (MST)" which was planned for the period of 2006-2009 with the objective of promoting MST by closely collaborating with all the parties involved (Norwegian Ministry of Education and Research). Through knowledge promotion the number of instruction hours in mathematics and natural science in basic education has been increased.

It is anticipated that the school and the apprenticeship-training enterprise shall,

- "give all pupils and apprentices/trainees equal opportunities to develop their abilities and talents individually and in cooperation with others (Section 1-2 of the Education Act and Chapter 5, and the Core Curriculum)
- stimulate the stamina, curiosity and desire of pupils and apprentices/ trainees to learn (Section 1-2 of the Education Act, and the Core Curriculum)
- stimulate pupils and apprentices/trainees to develop their own learning strategies and critical-thinking abilities (Section 1-2 of the Education Act, and the Core Curriculum)

- stimulate pupils and apprentices/trainees in their personal development, in the development of identity and ethical, social and cultural competence, and in the ability to understand democracy and democratic participation (Section 1-2 of the Education Act, and the Core Curriculum)
- facilitate for pupil participation and enable pupils and apprentices/trainees to make informed value choices and choices relating to their education and future professions/occupations (Section 1-2 of the Education Act, Chapter 22 of the Regulations and the Core Curriculum)
- promote adapted teaching and varied work methods (Section 1-2 of the Education Act and Chapter 5, and the Core Curriculum)
- stimulate, use and further develop each teacher's competence (Chapter 10 of the Education Act)
- help teachers and instructors to be seen as positive leaders and as role models for children and young people (The Core Curriculum)
- ensure that the physical and psychosocial working and learning environments promote health, well-being and learning (Chapter 9a of the Education Act)
- facilitate for cooperation with the home and ensure the co-responsibilities of parents and guardians (Section 1-2 of the Education Act and section 3-2 of the Regulations)
- ensure that the local community is involved in the education in a meaningful way" (National Curriculum for Knowledge Promotion in Primary and Secondary Education and Training, Norwegian Ministry of Education and Research Education)

The objectives of the Norwegian national curriculum reflect greater autonomy for both teacher and the learner. It aims at promoting adapted teaching characterized by variation in the use of subject materials, ways of working, teaching aids, as well as variation in the structure and intensity of the education (Norwegian Ministry of Education and Research Education). Adapted teaching helps sustain inclusive education. Equality is a fundamental principle in the Norwegian society and the education aims at providing equal opportunities to all students regardless of their gender, age, social, geographical, cultural or language background. The national curriculum has laid down the collective objectives of teaching at primary and lower secondary levels and the subject curricula lay down the common content to be taught in all schools but the teachers are free to adapt it to the needs of students (Norwegian Ministry of Education and Research). Therefore in contrast to the Sri Lankan

national curriculum, Norwegian national curriculum lay down guidelines which sustain the need for autonomy for both teachers and learners. The Norwegian education is outcome-based.

In the Norwegian subject curricula a timeframe is given to achieve the competences. All subject curricula have competence aims to be achieved after grades 4, 7 and 10 and after each level in upper secondary education and training. Also in some subjects there are competence aims to be achieved after grade 2 (Norwegian Ministry of Education and Research Education). Therefore the Norwegian curriculum has provided autonomy to the teacher to choose which competence aims are to be achieved at a certain grade ensuring adapted teaching. The competence aims for natural science to be achieved between grade 7 and grade 10 which are the relevant competence aims for the target population of this research are given below.

The budding researcher

The aims of the studies are to enable pupils to,

- formulate natural science questions about something one wonders about, provide possible explanations, create a plan and carry out examinations and investigations
- converse about why it is important to make and test hypotheses in natural science through systematic observations and experiments, and why it is important to compare results
- use digital aids to register, prepare and publish data from experimental work and fieldwork
- extract and process natural science information from texts from different media and create a presentation
- read and understand hazard labels on everyday products

Diversity in nature

The aims of the studies are to enable pupils to,

- plan and execute investigations in at least one nature zone, register one's own observations and systemize the results
- examine and describe flowering plants and explain the functions of the different parts of a plant using text and illustrations

- examine and discuss some of the factors that influence the germination and growth of plants
- describe the characteristics of some plants, mushrooms and animal species and put them in systematic order
- tell others about how some plants, mushrooms and animal species are used according to tradition, including Sami traditions, and discuss whether this use is sustainable

Body and health

The aims of the studies are to enable pupils to,

- talk about the development of the human body from conception to adulthood
- explain what happens during puberty and talk about gender identities and variation in sexual orientation
- describe the main features of the circulatory system and what functions it has within the body
- explain how the body protects itself against illness and how one can prevent and treat infectious diseases
- collect information and statistics and discuss dangers to one's health that can result from substance abuse

Phenomena and substances

The aims of the studies are to enable pupils to,

- use animation and other kinds of models to describe planetary and moon movements and explain how the reasons for the earth’s seasons and the phases of the moon
- describe how some minerals and rock types were formed and examine some of these types from nearby surroundings
- elaborate on the use of some sources of energy, past and present, and gather information and statistics from different sources to describe the possible local and global consequences for the natural environment when using such energy
- explain the concept of climate, be familiar with some causes of climate change and investigate and record the consequences of extreme weather

- investigate phenomena related to sound, hearing and noise, discuss these observations and explain how sound can damage hearing
- carry out experiments with magnetism and electricity and explain and present results
- describe central characteristics of gases, liquids, solids and phase transitions using the particle model
- explain the structure of substances and how substances may be transformed, by using the concepts of atoms and molecules
- carry out experiments with different chemical reactions and describe what characterizes them

Technology and design

The aims of the studies are to enable pupils to,

- plan, build and test mechanical toys and explain the principles of mechanical transfer
- plan, build and test simple products that use electrical energy and explain and promote the qualities of the finished product
- describe the lifecycle of a product and discuss whether the product is developed in accordance with sustainable development

(The Norwegian Directorate for Education and Training (Udir), http://www.udir.no/kl06/NAT1-03/Hele/Kompetansemaal/Kompetansemal-etter-7-arstrinn/?lplang=eng)

The science teachers are free to operationalize these broad competence aims in to workable topics depending on the requirements of the learners. Following are the topics one participant school had chosen for grade 10.

1) Organic chemistry, forming of fossil fuels
2) Global warming
3) Mechanics - force and acceleration, gravity, mass, friction etc.
4) Health and carbohydrates, introduction to traditional and alternative medicine
5) Cell biology, genetics, evolution theory
6) Nature management, conservation
7) Energy: energy laws, energy production

In addition grade 10 students in this school had to conduct their own research project in order to understand how scientists work following the scientific method. However all three schools participated in this research used the same text book Eureka! 10.

3 Theoretical considerations and literature review

This chapter elaborates the theoretical base underpinning the study and presents a review of relevant literature. Due to the centrality of theory in this study it would be pragmatic to present the theory and literature hand in hand in one chapter. An overview of the theory is presented with operational definitions of the key concepts followed by a review of motivational studies conducted in the two countries.

3.1 Overview of self-determination theory

Any study of motivation is a journey of exploring the energization and direction of behaviour (Deci & Ryan, 1985). SDT adequately addresses both these requirements unlike many other contemporary motivation theories. When considering the motivational theories suitable to guide this research it was convinced that in SDT the above two aspects of behavior are well addressed. The aspect of energization or arousal of a behaviour is essentially a matter of needs and for a comprehensive motivation theory it is required to address both the organisms' innate needs and the needs that arise by interacting with the social world (Deci & Ryan, 1985). Fundamentally, behaviour is aimed at the satisfaction of needs. The SDT satisfactorily addresses this aspect by postulating about three basic psychological needs of humans. These needs are the needs for competence, autonomy and relatedness. They will in fact contribute to the understanding of *why* a certain behaviour is performed and in this specific context will contribute to explore *why* students are motivated or not motivated to learn science.

Direction of behaviour on the other hand concerns the processes and structures of an organism that directs an organism towards a certain behavior which ultimately satisfy needs (Deci & Ryan, 1985). SDT has comprehensively discussed about this issue mainly in organismic integration theory and causality orientations theory. Therefore SDT satisfies the two essential requirements of an adequate motivation theory.

The key concepts at the core of SDT are self, regulatory styles and human needs. SDT has an organismic dialectical approach where a main assumption is that human beings are inherently active, inquisitive and strive to achieve goals. Also, SDT states that depending on socio-contextual factors this fundamental human nature can be either supported or hindered.

The SDT has its conception within cognitive evaluation theory where the SDT theorists attempted to study the effects of socio-contextual variables on intrinsic motivation. However, the theory has subsequently developed in to a broad framework which now comprises of six mini theories. They are,

1. Cognitive Evaluation Theory (CET)
2. Organismic Integration Theory (OIT)
3. Causality Orientations Theory (COT)
4. Basic Psychological Needs Theory (BPNT)
5. Goal Contents Theory (GCT)
6. Relationships Motivation Theory (RMT)

All mini theories are built upon the fundamental elements: organismic and dialectical assumptions and basic psychological needs concept. Thus, they are integratable to each other (Deci & Ryan, 2002). Therefore SDT provides a broad conceptual framework to study human motivation and personality than any single motivation theory. Moreover, SDT has substantial empirical validation and was considered to be selected as the theoretical framework in this research.

Another reason for selecting SDT as the theoretical framework was the utility of organismic integration theory. OIT presents a theoretical framework to which the research problem in question can be fitted conveniently. OIT discusses about a general organismic integration view of human development. This mini theory presents a more differentiated view of internalization process and the styles of self-regulation that accompany different degrees of internalization (Deci & Ryan, 1985). A student's motivation to learn science fluctuates depending on the level of internalization of science learning to self. Therefore if this theory was selected as the theoretical base it seemed possible to evaluate the differing levels of internalization of science learning and thereby conclude the level of self-regulation of students' science learning.

As Deci and colleagues point out, most current motivational theories revolve around the concept of intention (Deci *et al*., 1991). They build upon a distinction between intentional and unintentional behaving or motivated and amotivated behaving (Deci *et al*., 1991). Nevertheless SDT makes a unique additional distinction within motivated or intentional behaving that it distinguishes between self-determined and controlled types of intentional

regulation. In order to be self-determined the person must have made a choice volitionally by one's self. The behavioural regulation will be controlled if a person is motivated by some interpersonal or intrapsychic force. "When a behaviour is self-determined, the regulatory process is choice, but when it is controlled, the regulatory process is compliance (or in some cases defiance)" (Deci *et al*., 1991, p.327). This distinction between self-determined and controlled types of intentional regulation enables to view the research problem in a broader manner unlike any other motivation theory. Due to all these reasons SDT was identified as the ideal theory to be employed to shed light upon the research problem and the research problem was adjusted to operationalize within the periphery of SDT.

Since theory is of central importance in this research, it would be useful to highlight the key concepts of each mini theory and identify the interrelations among concepts in order to comprehend the macro theory.

3.1.1 Cognitive Evaluation Theory

Cognitive evaluation theory concerns the effect of social contexts on intrinsic motivation. The theory distinguishes contexts as autonomy supportive, controlling and amotivating linking them to different types of motivation (Deci & Ryan, 2002).

If we conceptualize intrinsic motivation it is the driving force when a person is engaging in an activity freely for the sake of inherent satisfaction. In such instances people engage in activities merely for the sake of pleasure, contentment and satisfaction they gain by doing those activities (Deci *et al*., 1991). "The activities are ends in themselves rather than means to an end" (Deci, 1975, p.23).

It is a choice a person makes volitionally and no external rewards or constraints have persuaded him to do so (Deci *et al*., 1991). Intrinsic motivation is the prototype of self-determination (Deci *et al*., 1991). SDT posits that intrinsic motivation is sustained when the needs for competence and autonomy are satisfied.

It is evident that intrinsic motivation in the realm of education leads to many positive consequences such as conceptual learning, task engagement, creativity, spontaneity and persistence. Therefore, studying the motivation patterns, regulatory styles and level of

internalization of students to learn science would reveal a wealth of information to different stake holders.

3.1.2 Organismic Integration Theory (OIT)

Organismic integration theory concerns about extrinsic motivation and it proposes four types of extrinsic motivation depending on the degree to which a regulation for a behaviour has been internalized and integrated to the self. This research is basically based on this mini-theory, thus, it will be useful to highlight the main concepts of the mini-theory.

Internalization, perceived locus of causality (PLOC) are the key concepts in the OIT.

Internalization

"The term internalization refers to the process through which an individual acquires an attitude, belief, or behavioural regulation and progressively transforms it into a personal value, goal, or organization" (Deci & Ryan, 1985, p.130).

Perceived locus of causality (PLOC)

The concept of perceived locus of causality enables to differentiate self-determined behaviour and controlled behaviour (Deci *et al*., 1991). If a person is self-determined he or she has a perceived locus of causality internal to him or herself. On the other hand, if a person is controlled in his behaviour the perceived locus of causality is external to the self (Deci *et al*., 1991).

Extrinsic motivation is instrumental in nature that they are performed as they are instrumental to some separable consequences (Deci *et al*., 1991). The behavior is not caused by the genuine interest of the person but by an external drive such as receiving a reward or avoiding a punishment. The drives are contingencies or reinforcements that are operationally separable from the activity (Deci & Ryan, 2002). Nevertheless four types of extrinsic motivation have been identified based on the concept of internalization. These four styles of extrinsic motivation that vary in their degree of autonomy are external regulation, introjected regulation, identified regulation and integrated regulation (Deci & Ryan, 1985). Since this mini theory forms the core of this research it is worthwhile to look in to concepts closely.

External regulation

External regulation which is the least self-determined and the least autonomous form of extrinsic motivation has a locus of initiation external to the person (Deci *et al*., 1991). For instance, the behaviour of a child who is studying with the intention of being appreciated by a parent or to avoid punishment is triggered by external regulation. The external contingency is considered as the locus of initiation and regulation of the behaviour which pressures the person towards certain behaviour (Deci *et al*., 1991).

Introjected regulation

Introjected regulation is somewhat external. Regardless of the fact that introjected regulation is internal to person it possesses characteristics of external control as it involves coercion or seduction and it does not allow the person to make a free choice (Deci *et al*., 1991). An example for this type of regulation is a student who tries to be punctual to the class to avoid the feeling of being a bad student (Deci *et al*., 1991). The student unconsciously incorporates in to his psyche the idea that being late is a bad thing or in other words he has introjected that not being punctual is an offence. He tries to be punctual to avoid the feeling of guilt. Therefore, "introjection based behaviour are performed to avoid guilt and shame or to attain ego enhancements and feelings of worth" (Deci & Ryan, 2002, p.17). An individual engages in a behaviour because if that person does not do that activity, he/ she will feel guilty for not doing it as it is internalized as a rule or demand that forces that particular person to behave (Deci *et al*., 1991). Due to the fact that introjected regulation is not part of integrated self, the behaviour caused by introjected regulation cannot be considered as self-determined (Deci *et al*., 1991).

Identified regulation

In identified regulation the person has identified the value of the behaviour and this identification allows the person to make a free choice (Deci *et al*., 1991). Also, the regulatory process has become a part of self and as a result the behaviour is more autonomous or self-determined compared to external contingencies and introjects. An example is a student who willingly does some extra exercises in Maths knowing that it would help him improve his performance. In this example the student consciously assesses the instrumentality of the behaviour and performs the behaviour subsequent to the identification of the importance of the behaviour.

Integrated regulation

Integrated regulation is a form of autonomous regulation and the locus of causality is internal to person. This occurs by integrating the regulatory process with the person's coherent sense of self (Deci *et al*., 1991). Although integrated regulations are self-determined they are still considered extrinsic due to the instrumentality of behaviour. The behaviour is not performed for enjoyment and interest but because of the personally important outcome (Deci & Ryan, 2002).

Autonomous motivation leads to greater persistence in the task. Since the autonomous learner is acting volitionally he deeply engages in the task extending his potential to unreached territories eventually leading to creativity in the activity. This cognitive flexibility is immensely advantageous to the autonomous learner who will master to think "out of the box".

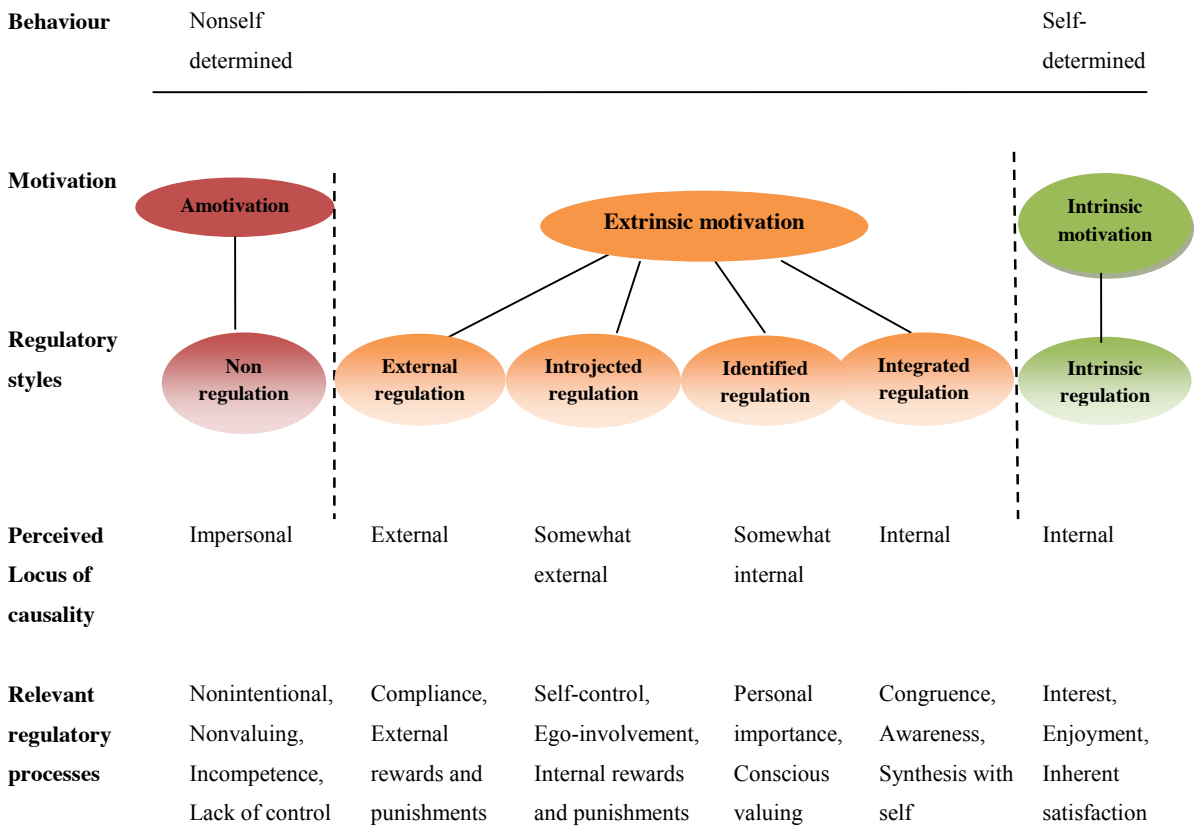


Figure 3.1 *The self-determination continuum showing types of motivation with their regulatory styles, loci of causality and corresponding processes*

Ryan, R.M., Deci, E.L., (2000). Self-determination theory and the facilitation of intrinsic motivation, social development and well-being, *American psychologist*, 55 (1), 68-78.

3.1.3 Causality Orientations Theory (COT)

Causality orientations theory concerns the different causal orientations of people and this mini theory specifies three causal orientations of people which are autonomous orientation, controlled orientation and impersonal orientation (Deci & Ryan, 2002). SDT emphasizes the importance of social contexts on a person's behaviour, motivation and experience and it assumes a person's behaviour, motivation and experience in a particular situation is a function of both the immediate social context and the accumulated inner resource of the person which he gains by previous experiences of interacting in different social contexts. This mini theory concerns this inner resource and develops a General Causality Orientations Scale (GCOS).

3.1.4 Basic Psychological Needs Theory (BPNT)

As aforementioned, SDT postulates about three broad basic psychological needs of humans which are the needs for competence, autonomy and relatedness. It hypothesizes the needs to be universal. When satisfied, needs promote well-being and in a context where they are thwarted negative outcomes can be caused (Deci & Ryan, 2002). Therefore, they form the basis for analyzing social contexts and differentiating them as supportive or impeding. This makes SDT more promising than most current motivational theories which are more focused on the outcomes and the processes which lead to those desired outcomes (Deci *et al*., 1991).

Autonomy

Autonomy is the volition, endorsement, willingness of one's own activity and behaviour. It is the initiation of an action by one's own will without being controlled, or in other words, being self-initiating and self-regulating of one's own actions (Deci *et al*., 1991). The opposite of autonomy is heteronomy which means controlled regulation (Ryan & Deci, 2006). Intrinsic motivation is the prototype of autonomy. SDT theorists emphasize that autonomy does not mean independence. It is possible for people to be autonomously independent and on the other hand, it is possible to be autonomously dependent on others. For instance, a patient who is visiting the doctor is doing this particular activity out of his own will in order to recover from the disease, but at this particular instance he is dependent on the doctor for his expertise.

Enhancing students' perceptions of autonomy has been found to have positive effects on their performance. Lavigne and colleagues showed that science teachers' support of students' autonomy positively influence students' perceptions of autonomy and competence which in

turn enhance students' self-determined motivation toward science (Lavigne, Vallerand, & Miquelon, 2007).

Competence

Competence is the ability to attain a certain goal. It is the capability of a person to achieve a desired outcome. "Competence involves understanding how to attain various external and internal outcomes and being efficacious in performing the requisite actions" (Deci *et al*., 1991, p. 327).

Higher perceived competence predicts higher levels of persistence intentions (Lavigne *et al*., 2007). The students with higher perceived competence persist in science education and eventually work in a scientific domain.

Relatedness

Relatedness is one's feeling of belongingness or feeling of being cared by someone. In the learning context students feel whether the teacher genuinely likes, respects, and values him or her depending on the need for relatedness. "Students who report such relatedness are more likely to exhibit identified and integrated regulation for the arduous tasks involved in learning, whereas those who feel disconnected or rejected by teachers are more likely to move away from internalization and thus respond only to external contingencies and controls" (Niemiec & Ryan, 2009, p.139).

These assumptions about innate human needs lay a strong foundation for SDT which enables us to understand why an individual is driven towards a certain behavior leading to a particular outcome. The incorporation of the innate human needs is useful in several ways. Firstly, it looks in to the existence of universal human needs. Secondly, this basic need dialog helps identify and link phenomena which would otherwise not be integrated at a superficial level. Thirdly, it enables to give due consideration to the contextual conditions (Deci *et al*., 1991). Individuals will behave optimally in situations where these three universal psychological needs are satisfied. Social contexts which satisfy at least one of these three needs will motivate a person, however, the need of autonomy must be satisfied for a person to be self-determined (Deci *et al*., 1991).

3.1.5 Goal Contents Theory (GCT)

The main concepts related to goal contents theory are intrinsic goals and extrinsic goals. GCT concerns how the goals are related to motivation and well-being. Endeavours related to community support, personal growth, forming close relationships are examples of intrinsic goals and these intrinsic goals foster the three basic psychological needs. In contrast, extrinsic goals often impede the three basic psychological needs thus lead to impaired well-being and learning (http://www.psych-it.com.au/Psychlopedia/article.asp?id=441). Examples of extrinsic goals are economic success, appearance, and fame (Self-determination theory).

3.1.6 Relationships Motivation Theory (RMT)

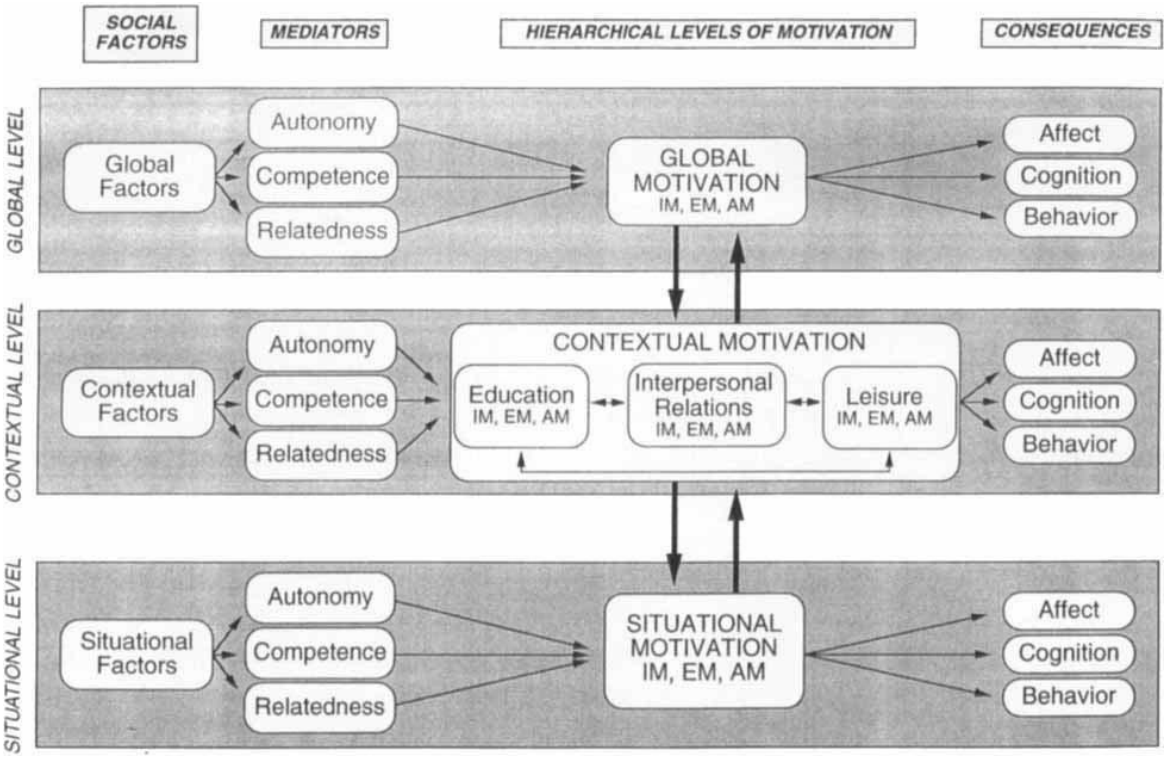
Relatedness is one of the three basic psychological needs and RMT is concerned with the importance of relationships in human well-being. A high quality relationship satisfies all three basic psychological needs. It posits that in a high-quality relationship, satisfaction of the need for autonomy is crucial.

Despite the plethora of studies conducted within SDT leading to solid empirical validation of its theoretical base, like for any other theory, there are arguments against SDT. The main argument is the universality of the basic needs. The need for autonomy as a universal need is criticized because majority of SDT work was conducted in North America and the argument is whether the need of an individualistic society will be perceived as a need to the same degree in a collectivistic society. Nevertheless, there are ample of studies conducted in collectivistic societies in Asia and Africa which have supported the universality of autonomy.

Another strong argument is the SDT's claim that rewards can diminish intrinsic motivation. SDT theorists have conducted both laboratory and field experiments which have provided first hand evidence for this claim. In fact during the time SDT was first introduced the field of motivation psychology was dominated by behaviourists and SDT which was out of the mainstream thinking was heavily criticized. SDT claims that introduction of rewards to an individual who is already driven by intrinsic motivation can be detrimental.

Based on the SDT framework, Vallerand constructs a hierarchical model (Figure 3.2) of the three types of motivations (Vallerand, 1997) which enables more precise and refined study of motivation. The model is based upon five postulates. Firstly, this model acknowledges the existence of the constructs intrinsic motivation, extrinsic motivation and amotivation and that

all three of these should be considered when dealing with motivation. Secondly, it postulates that the three types of motivation exist at three levels of generality: global (or personality), contextual (or life domain) and situational levels (or state). Situational motivation occurs as the immediate result of situational variables like rewards, deadlines or punishments. Contextual motivation is the motivation one shows for a specific life context (e.g. education, sports, religion) whereas global motivation is the general motivational orientation of the individual that is intertwined with his or her personality.



IM= lntrinsic Motivation. EM = Extrinsic Motivation. AM = Amotivation

Figure 3.2 The Hierarchical Model of Intrinsic (IM) and Extrinsic Motivation (EM). AM: Amotivation (From Vallerand, 1995)

Source: (Vallerand, 1997)

Thirdly the hierarchical model postulates that motivation is determined by social factors that are global, contextual or situational depending on the level of generality. The perceptions of autonomy, relatedness and competence that result from the interactions with social factors, act as the mediators of motivation. Furthermore, the hierarchical model postulates that motivation has a top-down effect meaning that a given motivation generates from top-down effect from

the motivation in the higher level in the hierarchy. The fourth postulate is the recursive bottom-up relationship between motivations, i.e. there is a recursive bottom-up effect of motivation at a particular level on the motivation at the proximal higher level in the hierarchy. The final postulate is that motivation results in important consequences and they are decreasingly positive from intrinsic motivation to amotivation. Also, the level of the motivation that has the given rise to the consequence determines the degree of generality of the consequences (Vallerand, 1997).

The motivation of a student to learn is a function of his or her immediate environment and also the motivational orientation of the learner (Grolnick & Ryan, 1987). The teacher's behaviour largely determines the school classroom climate. A learning context can be either nondirected or directed. In nondirected or spontaneous learning there is no external directive that directs the student towards an explicit learning outcome. In contrast, learning that occurs in a directed context is driven by an explicit external directive towards a specified learning outcome. Directed learning which is also known as intentional learning can range from being controlling to noncontrolling. Both controlling and non-controlling orientations of directed learning promote greater rote learning compared to nondirected learning (Grolnick & Ryan, 1987). Both nondirected and noncontrolling orientation of directed learning has resulted in greater interest and conceptual learning compared to controlling orientation of directed learning. The retention of information resulting from learning with an instrumental focus is shorter compared to retention of information from more self-determined learning (Grolnick & Ryan, 1987). An autonomy-oriented teacher uses rewards and communication for informational purposes whereas a controlling teacher's uses rewards and communication for controlling purposes (Deci & Ryan, 1985).

This study is a cross-cultural research and the two countries participating in this research culturally lies at two poles. Sri Lankan culture is predominantly collectivistic whereas Norwegian culture is predominantly individualistic. It is more accurate to view individualism and collectivism as two different worldviews rather than considering them as simple opposites. In collectivism mutual obligations are central whereas in individualism the core assumption is that individuals are independent of one another (Oyserman, Coon, & Kemmelmeier, 2002).

3.2 Review of literature in the Sri Lankan context

There is a comparative lack of educational psychology research conducted in Sri Lanka and published research works conducted in light of SDT were absolutely nonexistent.

There are researches conducted on practices employed by secondary level science teachers to foster science achievement in students and examining how these practices related to self-regulated learning in science (Jayawardena, Kraayenoord, & Carroll, 2016). It has been revealed that secondary level science teachers utilize practices such as goal setting, modeling, scaffolding, and developing learner autonomy to help foster self-regulated learning among learners (Jayawardena *et al*., 2016). Jayawardena states that teaching practices recommended for implementing self-regulated learning such as problem-solving and critical thinking were not prominent in her particular case study. Studies show that the overloaded curriculum and limited resources are barriers for teachers to implement self-regulated learning in Sri Lanka (Jayawardena *et al*., 2016).

As stated in the introduction chapter, a student-centered method is practiced in Sri Lanka where self-regulated learning is vital in this context. However, there is research evidence that the curriculum does not fully embrace student-centered methods (Egodawatte, 2014). The recommended teaching-learning methods given in the teacher guides following the 5E structure rather sets a rigid framework and sets a monotonous tone to the pupil by incorporating group work to majority of the activities. The 5E system is less accepted in the school system (Perera, 2009).

In the Sri Lankan school system marks are given to pupils from primary classes in contrast to Norway where grades are not given in primary classes. In the Sri Lankan context marks play a critical role in students' perceptions of their academic competences. A research conducted to measure the relationship between self-concept of academic ability and academic achievement measures of secondary level school children in Sri Lanka has revealed that there is high influence of academic achievement measures on the formation of self-concept of academic ability (Wannigama, 2005).

Teachers are also human beings; they also require the basic psychological needs satisfaction in order to be self-determined and act volitionally in their career. Nevertheless majority of Sri

Lankan government school teachers themselves are dissatisfied with lack of work autonomy and job security (Kasturi Arachchi & Edirisinghe, 2011).

3.3 Review of literature in the Norwegian context

There are studies that have been conducted using SDT as the theoretical perspective in the Norwegian context (Valås & Søvik, 1993; Diseth & Samdal, 2014; Jeno & Diseth, 2014; Diseth, Danielsen & Samdal, 2012). Valås and Søvik (1993) conducted a cross-sectional and longitudinal study to empirically test intrinsic motivation in human behaviour as explained by SDT. The samples consisted of Norwegian seventh and eighth graders. It was concluded that the students' perceptions of their mathematics teacher's controlling orientation affect their intrinsic motivation for mathematics as well as their self-concept in mathematics/academics (Valås & Søvik, 1993). Students who perceived their mathematics teacher as more autonomy supportive than controlling were more intrinsically motivated and reported more perceived competence in mathematics. Furthermore in this study it has been revealed that students who perceived their teachers as more autonomy supportive achieved higher in mathematics.

In the Norwegian context studies show that academic achievement (perceived school performance) is related to students' perceptions of their teachers' autonomy support as well as the students' own motivation for learning (Diseth & Samdal, 2014). This study was conducted with Norwegian students in their final year of lower secondary education (10^{th} grade) and their first year of upper secondary education (Vg1). It has shown that achievement goals (mastery, performance approach and performance avoidance) were positively predicted by autonomy support (Diseth & Samdal, 2014). Vg1 students had scored a higher mean level for all motivational variables. A gender difference was observed with regard to the importance of mastery goals and performance goals. Mastery goals had been more important for girls than boys, whereas boys had placed more importance on performance goals than girls.

A study conducted to investigate Norwegian students' perceived autonomy support from their teacher, their basic need satisfaction, self-regulation and perceived competence has findings supporting a motivational model in accordance with SDT (Jeno & Diseth, 2014). It has revealed that students' perceived autonomy support predicted their need satisfaction, which in turn predicted autonomous self-regulation, perceived competence and perceived school

performance. The study also revealed that students in the same class had a similar experience with regard to autonomy support.

Diseth and colleagues have studied the correlation between teachers' support of basic psychological needs and self-efficacy, achievement goals, life satisfaction and academic achievement using Norwegian 8th and 10th graders. The correlation analysis has shown significant positive relations between all of the variables, except for the relation between need support of competence and performance goals (Diseth *et al*., 2012).

The Norwegian students' choice in science subjects in the upper secondary school is predominantly driven by extrinsic motivation. In a study conducted to investigate the relevant importance of various issues in Norwegian upper secondary students' choices of post-compulsory subject combinations, it has been revealed that with regard to the "utility value for university admission" construct science students have scored more compared to the languages, social science and economics (HumSoc) students (Bøe, 2012). Utility value is a determinant of extrinsic motivation (Ryan & Deci, 2000), however, the students might have had autonomous motivation (i.e. either identified or integrated regulation) which was not explored as such in the study. Moreover, importance of utility value for university was higher for science girls than for science boys (Bøe, 2012). It is evident that external contingencies are determining girls' choices. Furthermore, the study reveals that science girls scored lower than HumSoc girls on the construct "importance of interest-enjoyment value" (Bøe, 2012). This finding suggests that the intrinsic rewards of learning science are less important to science-girls in comparison to their HumSoc counterparts. Majority of students choose science for strategic reasons compared to HumSoc students meaning science students are more extrinsically motivated compared to HumSoc students.

As stated in Chapter 2, Norwegian classroom is multiethnic and multicultural. Ethnic minority students are more responsive in the science classroom when extrinsically motivated compared to Norwegian majority students (Elstad & Turmo, 2009). They respond more positively to instrumental motivation and academic pressure in comparison to their counterparts. Furthermore, academic pressure could stimulate girls to engage in critical thinking in science (Elstad & Turmo, 2009) which illustrates that extrinsic motivation could enhance deep engagement of the task.

3.4 Review of studies which employed SRQ-A

SRQ-A has been used by numerous researchers across different cultures for researches with different orientations (Grolnick & Ryan, 1987; Tonks, 2006; Dettweiler, Ünlü, Lauterbach, Becker, & Gschrey, 2015; Thuneberg, 2007; Murray, 2005). The SRQ-A has been modified by different researchers depending on the different contextual requirements identified by them. The content validity of SRQ-A when administered in Eastern cultures has been questioned by the work of some researchers. For example, a Japanese version of the SRQ-A has shown higher content validity for Japanese students (J-SRQ-A) than the original SRQ-A (Tonks, 2006). Preliminary interviews conducted with Japanese students focusing on why they engage in academic behaviour, have revealed reasons for academic behaviour which are not addressed in SRQ-A. In fact four out of the five most frequently stated reasons for academic behaviour are not represented in the original SRQ-A Consequently, eight more items belonging to three groups of reasons are included in J-SRQ-A (Tonks, 2006). SRQ-A is criticized in terms of construct equivalence in cross-cultural research due to its inadequacy in acknowledging certain salient academic behaviour in non-Western cultures (Tonks, 2006).

Thuneberg in her cross-sectional study analyzing psychological well-being at school has employed SRQ-A for general, special and selective education students in Finland (Thuneberg, 2007). Dettweiler and colleagues have used the German version of SRQ-A to study the psychological aspects of an outdoor science learning programme (Dettweiler *et al*., 2015). They have found that lower self-regulated pupils in "normal" science classes show a significantly higher self-regulated learning motivational behavior in the outdoor educational setting, and that the outdoor-teaching has generally been perceived as more practical than teaching at the normal school context, irrespective of gender or school culture. Murray employed SRQ-A to study Korean students' motivation to learn English as a foreign language and found that students are extrinsically motivated to learn English and the predominant regulatory style is identified regulation (Murray, 2005).

4 Methodology

This chapter will present the methodological approach employed in this study.

4.1 Research strategy

A substantial amount of the motivational research has traditionally opted for quantitative research strategy (Grolnick & Ryan, 1987). As Creswell & Plano points out it can be argued that quantitative research has the limitation of not understanding the context and that participant voices are not directly heard. Qualitative research on the other hand suffers a major criticism regarding the limitations to generalization. There are few studies which have opted for mixed methods studies. However mixed methods research should not be considered as superior to single research strategy guided research (Bryman, 2012).

Why mixed methods?

There are two reasons originated from the research questions which led to the choice of mixed methods strategy. First reason is associated with the orientation of the second research question. The second research question of this study looks in to the basic psychological needs satisfaction of students in the two countries. The proposition of basic psychological needs is at the core of SDT. Hence, no study of SDT would be complete without addressing to the prerequisite of basic needs for self-determination. Basic Psychological Needs Satisfaction at School (BPNS) questionnaire could have been selected as the research instrument in this regard. However, incorporating two questionnaires would make the study exhaustive and unfeasible. The second reason was the significance of understanding the context to be able to conduct meaningful comparisons. Quantitative research provides a general understanding of a problem whereas qualitative research provides a detailed understanding of a problem. A pure quantitative study may hinder the researcher grasp a holistic idea of the research problem. Since the researcher was not familiar to the Norwegian school education system, mixed methods strategy was identified as the best option. It was necessary to conduct interviews leading to open ended answers for the acquisition of a holistic picture of the problem. Students were the major participant group in the study and in order to get a broader and deeper understanding of students' attitudes, perspectives and gain rich contextual information the researcher opted to combine a qualitative method. The need to combine objective

knowledge and subjective knowledge was identified as a need for knowledge production in this instance.

Furthermore, teachers' attitudes and stance regarding students' self-regulation to learn science needed to be incorporated and the best option for this inclusion was qualitative interviews. Choosing a quantitative method to obtain teachers' perspectives could lower the resources and energy that could otherwise be used to collect a richer quantitative data set from students. In fact it was necessary to obtain an in depth understanding about teachers' perspectives than a general understanding because it could help shed light upon the findings. Therefore qualitative interviews were used as the research instrument and hence it was required to mix quantitative and qualitative methods which appeared to be mutually informative in this case.

Nevertheless to best answer the research questions enabling the researcher gain a broader, in depth view of the research problem, mixed methods research strategy was employed in this research. According to Creswell & Plano when defining mixed methods research it is necessary to incorporate the key characteristics of mixed methods research. "In mixed methods, the researcher

- Collects and analyzes persuasively and rigorously both qualitative and quantitative data (based on research questions);
- Mixes (or integrates or links) the two forms of data concurrently by combining them (or merging them), sequentially by having one build on the other, or embedding one within the other;
- Gives priority to one or to both forms of data (in terms of what the research emphasizes);
- Uses these procedures in a single study or in multiple phases of a program of study;
- Frames these procedures within philosophical worldviews and theoretical lenses; and
- Combines the procedures into specific research designs that direct the plan for conducting the study." (Creswell & Plano, 2011, p.5).

There are two strong arguments against mixed methods research. One argument is that research methods are rooted in epistemological grounds and questions how different methods can be blended in a single research. The second argument which is closely linked to the first raises the fact that quantitative and qualitative researches have separate paradigms. The

researchers supporting this argument consider quantitative and qualitative research as paradigms which constitute of closely interconnected sets of philosophical elements and that they have their own solid demarcations (Bryman, 2012).

A researcher should make four key decisions when selecting a mixed methods design (Creswell & Plano Clark, 2011). These decisions are,

1. The level of interaction between the strands
2. The relative priority of strands
3. The timing of strands
4. The procedures for mixing the strands

The level of interaction between the two strands was independent level of interaction in this study. The mixing of quantitative and qualitative strands will be done during the interpretation stage of the research. Moreover, the research was shaped by a quantitative priority i.e. QUAN + qual research. A higher number of participants participated in the quantitative component compared to the qualitative component and hence a higher data volume was collected from the quantitative part. The rationale behind this design is the perception that inclusion of a higher number of participants and acquiring a general understanding will be more representative of the population especially in this cross-cultural case. Although the objective is not making generalizations more weight was placed on the quantitative strand. Further in the results and discussion chapter, qualitative data will be used for data triangulation as multiple operation or research strategies make the data more valid. The timing of the two strands was concurrent timing since both types of data was collected simultaneously. Quantitative strand was done first as one had to go first but the sequence could be one way or the other. Therefore a convergent parallel design guides this research. Quantitative and qualitative strands were implemented in the same phase of the study, they were conducted separately, analyzed separately and were mixed in the interpretation stage.

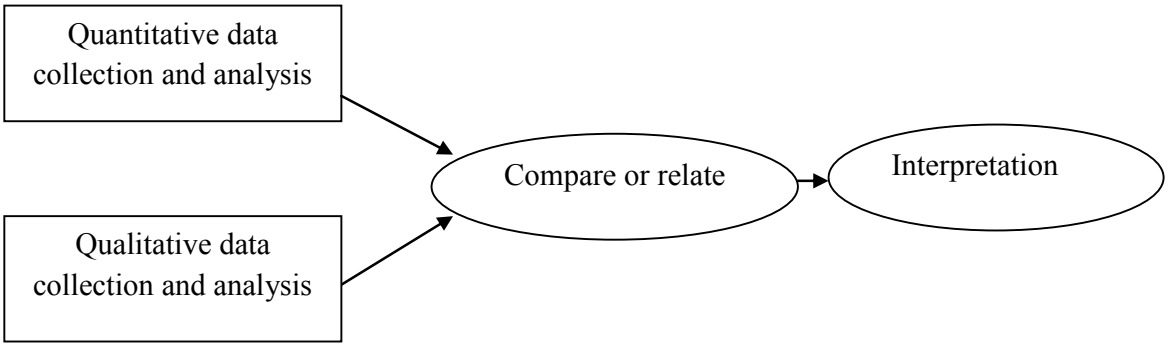


Figure 4.1 The convergent parallel design

Source: (Creswell & Plano, 2011, p.69)

The researcher adopts a pragmatist worldview in this research. Pragmatism is a practical worldview which gives prime importance to the research questions and via being pluralistic with regard to methods aims to shed light upon the research problem (Creswell & Plano, 2011).

> "The focus of pragmatist world view is on the consequences of research, on the primary importance of the question asked rather than the methods, and on the use of multiple methods of data collection to inform the problems under study. Thus, it is pluralistic and oriented toward "what works" and practice." (Creswell & Plano Clark, p.41, 2011).

According to Crewell & Plano pragmatism is typically associated with mixed methods research and Tashakkori and Teddlie (2003a) suggested that at least 13 different authors have opted for pragmatism as the worldview for mixed methods research (Creswell & Plano, 2011).

Adopting pragmatism as the paradigm necessitates the researcher to adopt a set of philosophical assumptions that are in the core of pragmatism. The ontological assumption guiding this research is that singular and multiple realities exist (Creswell & Plano, 2011). This assumption guides the thinking of the researcher that the existence of a single theory that can explain the research problem and the fact that different individual perspectives are required to thoroughly understand the research problem, both are acknowledged by the researcher.

The epistemological assumption is practicality - that is researcher collect data by "what works" to address research question (Creswell & Plano Clark, 2011). The researcher does not adhere to a rigid dichotomy between objective and subjective knowledge and selected methods adopting the "what works best to cater to the needs of the research problem" strategy.

With regard to axiology or the role of values, the researcher uses multiple stances i.e. researcher includes both biased and unbiased perspectives (Creswell & Plano Clark, 2011). The rhetoric adopted in this research will be a combination of formal and informal styles of writing.

4.2 Research sites

The purpose of the study is to investigate how same age students in different education systems are self-regulated to learn science. Therefore, Norway and Sri Lanka are chosen as the research sites. Sri Lanka is chosen because it is the home country of the researcher. On the other hand, due to the comparative inadequacy of published research work in the field of educational psychology conducting a research in Sri Lanka would be a valuable contribution to the existing body of literature. In Sri Lanka, the capital Colombo was chosen as the research site. In order to conduct an international comparative study, Norway is chosen as the other research site as it is the current study destination of the researcher and it has considerable differences in the education system opposed to Sri Lanka. Oslo, the capital of Norway was chosen as the research site due to practical convenience.

Schools

In the sampling process, initially it was planned to conduct random sampling adhering to probability sampling. Firstly, randomly selected schools in Norway were contacted via emails to seek permission; however, the responses were not satisfactory. It was convinced that random sampling was not pragmatic in the Norwegian context and that purposive sampling has to be employed. At this point no positive response had been received from any school in Norway, thus, it was decided to conduct field work in Sri Lanka first.

In Sri Lanka, Colombo district in the Western province was chosen for the research. Four schools in Colombo district were selected via convenience sampling. All four schools were

mixed schools where co-education was practiced. One school was a national school and one school was selected from Sri Jayewardenepura education zone and the other two from the Homagama education zone. During the selection of schools in Norway it was impractical to select schools randomly due to the difficulty in obtaining permission to access schools and therefore it was decided to do convenience sampling for both countries.

Prior to the commencement of the study ethical approval was obtained from the Norwegian Social science Data service (NSD). Permission was sought from the Director of national schools at the ministry of Education Sri Lanka to conduct the research at the national school and permission was sought from the respective zonal education directors to access the provincial schools. Subsequently, permission was obtained from each principal to conduct the research. Henceforth following abbreviations will be employed to refer to the Sri Lankan schools.

SL1 : National school

SL2 : Provincial school located in Sri Jayewardenepura education zone

SL3 : Provincial school located in Homagama education zone

SL4 : Provincial school located in Homagama education zone

SL1 was a reputed national school in Sri Jayewardenepura education zone where science stream was available for A/Ls in both Sinhala and English medium. SL2 also offered A/L science in both Sinhala and English medium. SL3 also had science subjects for A/Ls and SL4 did not have A/L classes. Almost all students in the Sri Lankan sample were Sinhalese.

Shortly after returning to Oslo, consent was received from three Norwegian schools to participate in the study. Therefore the selection was done through purposive sampling. The Norwegian school administration was less bureaucratic compared to the Sri Lankan context and permission from the rectors was sufficient to access the schools. All three schools practiced co-education. The abbreviations of the schools are as follows.

N1 : A school located in Bærum municipality

N2 : A school located in Rælingen municipality

N3 : A school located in Oslo municipality

The N1 school sample consisted only of ethnic Norwegian students. N2 school was a lower secondary school where only grade 8, 9 and 10 were there. N3 school had students with immigrant background.

4.3 Participants and selection method

In both countries the research participants were male and female students studying in Grade 10 and teachers teaching science to Grade 10 students. Random sampling was employed to select students for the quantitative part of the study. However, only students who were above 15 years of age were included in the sample. Following a verbal explanation by the researcher about the purpose of the research and issues of confidentiality, written consent was obtained from the students prior to the research. It was emphasized that the participation is voluntary and they can withdraw from the research at any moment.

In the sample selection for the qualitative research component, purposive sampling and random sampling were combined. Gender based participant selection was purposive in nature and subsequently participants were selected randomly. In certain schools the teacher chose the respondents for the qualitative strand.

4.4 Data collection and analysis methods

4.4.1 Quantitative strand

In order to collect quantitative data in the two countries a questionnaire was the best instrument. “A questionnaire is a collection of questions administered to respondents” (Bryman, 2012). A questionnaire arranges a set of questions in a logical and systematic manner which is designed to gather the information required to answer the research questions. Initially a preliminary questionnaire was developed by the researcher to measure students’ motivation to learn science utilizing SDT as the theoretical perspective. Nevertheless it was abandoned and the SRQ-A developed by the SDT theorists was employed as the data collection instrument (Appendix I A).

The rationale behind choosing this questionnaire was, it emerged as a promising instrument to measure students' motivation styles as well as the regulatory styles. SRQ-A had been used by many researchers across different cultures (Dettweiler *et al*., 2015; Murray, 2005; Tonks, 2006; Thuneberg, 2007) and the reliability and validity of the questionnaire had been satisfactory and consequently it appeared to be a reliable instrument to collect quantitative data regarding students' self-regulation. Following the development of a new questionnaire validity and reliability have to be checked and rather than SDT itself was a broad framework which consisted of six mini theories and it was required to narrow down the scope of the research. After studying the theory and the ready-made questionnaires carefully it was decided that SRQ-A would best help understand the self-regulation of students to learn science.

Reliability is basically concerned with issues of consistency of measures (Bryman, 2012). It is the repeatability of the questionnaire to get the same results. Validity concerns the extent to which a given indicator measures the concept that it intends to measure (Bryman, 2012). Ryan and Connell have presented the first validation of this questionnaire in 1989 (Ryan & Connell, 1989) and afterwards certain other authors have done validation factor analysis.

Academic Self –Regulation Questionnaire (SRQ-A)

This questionnaire is designed for students in late elementary and middle school and the questions concern the reasons why students do their school work. The responses are on a four point scale and the structure of the questionnaire is such that there are four stem questions inquiring about a certain behaviour related to school work and eight possible reasons are given for each stem question. Therefore, the questionnaire consists of 32 items all together. (Appendix IA). This format was introduced by Ryan and Connell (Ryan & Connell, 1989). The SRQ-A is developed on four subscales which are external regulation, introjected regulation, identified regulation and intrinsic motivation. It measures three types of extrinsic motivation (external, introjected and identified) and intrinsic motivation. It has been found that integrated regulation is difficult to measure in school children with high validity and reliability and consequently, being omitted during the development of SRQ-A.

Ryan and Connell using the students' self-reported reasons for certain behavior in school developed a model of PLOC. Furthermore, their application of this model in to four samples have shown conformity of external, introjected, identified and intrinsic types of reasons to a

simplex-like (ordered correlation) structure. In a simplex structure, when the correlations between the variables are studied, the ones with higher conceptual similarity should result higher correlations. When the variables are arranged according to their conceptual similarity in a correlation table, the highest correlations should appear in the diagonal. Ryan and Connell's work had fit in to a perfect simplex-like structure confirming the existence of self-determination continuum.

In the original work they have developed SRQ for academic and prosocial domains. There are two versions of the SRQ-A, one version for the normal classroom and the other for students with learning disabilities. The standard questionnaire aimed at an average student was used in this research. However, the questionnaire needed to be slightly adjusted to suit science learning. Therefore the wordings of all four stem questions were adjusted to suit science learning in such a way that the prime objective of the question was not damaged (AppendixIB, IC).

Furthermore, a second section was included to the questionnaire to obtain background information regarding student's gender, career ambition, continuity of science in further education, gender stereotyped views of science, parents' occupations and educational levels which would be useful in understanding the findings. The background information was important in understanding the cross-national similarities and differences in student attitudes regarding science and they would be used in the results and discussion chapter for in depth analysis of the research problem. Also, this data can even be used for a secondary analysis in future as these data cannot be fully utilized within the scope of this thesis.

The original questionnaire which was in English had to be translated to Sinhala and Norwegian as students will best respond in their mother tongue. Back-translation procedure was used in the translation phase. Back-translation procedures are identified as an effective translation procedure in cross-cultural research eliminating major translation problems (Brislin, 1970). The source language (English) questionnaire was translated to target (Sinhala) language by the researcher whose mother tongue is Sinhala. Then the target language (Sinhala) translation was translated back to source (English) by a bilingual. The two source versions were compared to see whether there are any ambiguities or discrepancies. Similar process was conducted for the Norwegian questionnaire also. Although it was planned to pre-test the questionnaires in the first place, it was understood to be unfeasible in the Norwegian context, hence pre-testing was not conducted in Sri Lanka also as similar conditions had to be

provided for both samples. This is a limitation of the study since piloting the questionnaire will enable the researcher to identify items with ambiguities and rectify them. Owing to the back-translation technique the final translated versions emerged to be satisfactory, however, few Sri Lankan students found the stem-question format in the questionnaire unfamiliar. It is doubtful even piloting can overcome this issue as the questionnaire format could not be altered. Nevertheless if this was identified in a pilot study, the researcher could be prepared more to face this problem in the field, for example, by allocating more time to describe the format of the questionnaire.

The questionnaire was administered to 100 randomly selected Grade 10 students in each country. The format of the questionnaire was described after obtaining written consent for participation. Instructions were given to students regarding how the questionnaire should be completed. The sample consisted of equal number of male and female participants. The questionnaire was completed within 15- 20 minutes hence it utilized only one school period for the completion of the questionnaire. In Sri Lanka one school period is 40 minutes and it is 45 minutes in Norway.

Data analysis

Subscale scores for external, introjected, identified and intrinsic subscales were determined for each student by averaging the item scores that constitute each subscale. The scoring system was Very true-4, Sort of true- 3, Not very true-2 and Not at all true-1. A higher score for a given subscale indicates higher endorsement of that regulatory style. The item numbers constituting each subscale are as follows.

External Regulation: 2, 6, 9, 14, 20, 24, 25, 28, 32

Introjected Regulation: 1, 4, 10, 12, 17, 18, 26, 29, 31

Identified Regulation: 5, 8, 11, 16, 21, 23, 30

Intrinsic Motivation: 3, 7, 13, 15, 19, 22, 27

Individual subscale scores as well as relative autonomy index (RAI) are used for analyses. RAI was calculated using the following formula.

2 X Intrinsic + Identified - Introjected - 2 X External

RAI is an indication of the autonomous motivation of the student. In the formula autonomous forms of regulation are weighted positive whereas non-autonomous regulatory styles are weighted negative. A positive RAI indicates that the student is autonomously motivated, the higher the positive value the more the student is autonomously motivated. A negative RAI indicates non-autonomous motivation. A higher negative RAI indicates the student is highly non- autonomously motivated and vice versa.

A total of students participated in the study. Listwise deletion of missing data was conducted by SPSS where all cases with missing data on any variable were omitted from the analysis. Eventually a similar number of cases (n=145) from each country were selected for the analysis.

The quantitative data was analyzed using the IBM SPSS statistics 22 software. Descriptive statistics and Pearson correlation coefficients were calculated to find the correlation between variables. However, "school-related motivation factors, attitude toward mathematics, and science and engagement in academic tasks, are complex factors that are difficult to measure with high reliability and validity" (Singh, 2002).

4.4.2 Qualitative strand

In order to collect qualitative data, semi-structured interviews were conducted to investigate about the students' motivation to learn science. The interview guide contained issues to be addressed during the interview (Appendix IIA, IIB). The questions were designed to collect data on the dependent variables autonomy, competence and relatedness. In Sri Lanka, interviews were conducted in Sinhala (students' and teachers' mother tongue) and in Norway interviews were conducted in English. The researcher took a pragmatic approach during the interviews conducted in Norwegian schools and was prepared to conduct interviews in either English or Norwegian depending on the respondent's language proficiency. However, all participants demonstrated adequate English language competence and language was not a barrier for effective communication. For the qualitative strand 4 students (2male and 2 female) and 2 teachers were interviewed from each country and altogether 12 interviews were conducted. One interview consumed 15-20 minutes. The coding system for the interviewees is as follows.

Sri Lankan male students : SL1M, SL2M, SL4M1

Sri Lankan female students : SL3F1, SL3F2

Sri Lankan teachers : SL1T, SL3T

Norwegian teachers : N1T, N2T

Norwegian male students : N1M1, N1M2, N2M1, N3M1

Norwegian female students : N1F1, N1F2, N3F1

All interviews were audiotaped upon acquisition of consent of the respondents. Transcription was done verbatim and coding was done via a deductive approach. The coding method utilized in this study was hypotheses coding where a list of researcher-generated codes derived from SDT were used to codify the raw data. Hypotheses coding is particularly suited for mixed methods research (Saldana, 2009). Since this study adopts a confirmatory approach via hypotheses testing it is the ideal method of coding in this context.

4.5 Units of analysis and level of comparison

This research is a cross-national research and as stated earlier it adopts a comparative design. Comparative research design has been popular in cross-cultural or cross-national research (Bryman, 2012). The comparison of a certain phenomenon in cross-national basis enables the researcher understand the phenomenon at international level. Therefore the level of analysis is country level. Data were collected for individual students and each student has a score for motivation in the form of relative autonomy index. Therefore the unit of analysis in this research is individual students. With reference to the framework for comparative education analyses proposed by Bray and Thomas (Bray, Adamson & Mason, 2007), the research can be readily placed in the cube at the intersection of following dimensions- 1) Geographic/ locational levels: Level 2 Countries 2) Non locational demographic groups: Other groups 3) Aspects of education: Other aspects (Motivation).

This research is purely a comparative and international study. The choice of a comparative design originated from the requirement set by the Comparative and International Education MPhil study programme. The incorporation of the international dimension was driven by the

researcher's deep curiosity and motivation for a cross national study. It provided a greater opportunity for the researcher to conduct empirical work in two countries and obtain hands-on experience in the field of comparative and international education.

5 Data analysis and Results

This chapter presents the data analysis and the results. Firstly, the quantitative data analysis will be presented followed by the qualitative data analysis.

5.1 Quantitative data analysis

5.1.1 SRQ-A data analysis and results (Part I of the questionnaire)

The quantitative data analysis answers the first research question and its sub question. Thus quantitative analysis concerns the motivation pattern for science learning among Sri Lankan and Norwegian 10^{th} graders and also whether there is a correlation between gender and motivation in the two countries.

The variables of the SRQ-A were extrinsic regulation, introjected regulation, identified regulation and intrinsic motivation. For each student subscale scores are computed for external, introjected, identified and intrinsic subscales. Using these subscale scores a RAI value is calculated for each student using the formula presented in chapter 4. The analysis of data suggests that both Sri Lankan and Norwegian students are extrinsically motivated to learn science. When the Sri Lankan students' regulatory styles are arranged in decreasing order it is as follows; identified, intrinsic, external and introjected. In the Norwegian sample it is identified, external, intrinsic and introjected. Therefore in both countries the predominant regulation style is identified regulation which is the most internalized form of extrinsic motivation measured by SRQ-A. In both countries introjected regulation is the least prevalent regulatory style among students as measured by SRQ-A.

The positive value of RAI indicates that the students are autonomously motivated in both countries. Sri Lankan students display a higher level of autonomous behavior (RAI= 0.82) for science learning compared to Norwegian students (RAI= 0.65). However, independent t-test was conducted to study whether there is a statistically significant difference between the two countries and it was found that there is no statistically significant difference between the mean RAI values obtained for the two countries ($t=0.725$, $p>0.05$). Therefore, both Sri Lankan and Norwegian students are equally motivated to learn science. The reliabilities of the variables showed sufficient internal consistency (Cronbach's alphas .71-.90).

Table 5.1 Descriptive statistics for SRQ-A

	Sri Lanka			Norway		
	Mean	SD	α	Mean	SD	α
External regulation	2.90	.51	.71	2.61	.50	.72
Introjected regulation	2.84	.56	.78	2.53	.55	.80
Identified regulation	3.56	.43	.78	3.24	.50	.78
Intrinsic motivation	2.95	.58	.80	2.58	.72	.90
Relative autonomy index (RAI)	0.82	1.78		0.65	2.12	
Valid N (List wise)	145			145		

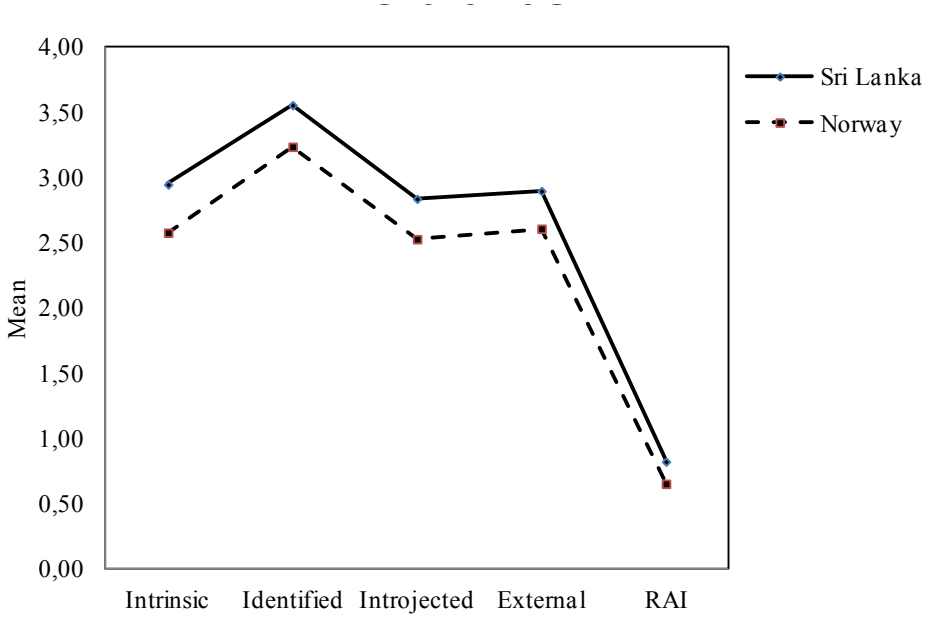


Figure 5.1 Regulatory styles of Sri Lankan Vs Norwegian students

When the sample is analyzed gender wise, Sri Lankan girls (RAI= 0.98) are more autonomously motivated than Norwegian girls (RAI= 0.12) whereas Norwegian boys (RAI= 1.11) are more autonomously motivated than Sri Lankan boys (RAI=0.68).

Sri Lankan girls are more autonomously motivated (RAI= 0.98) than Sri Lankan boys (RAI=0.68). Interestingly in the Norwegian context boys (RAI= 1.11) are more autonomously motivated than girls (RAI= 0.12). Sri Lankan girls' regulatory styles when arranged in

decreasing order are similar to the whole country pattern which is identified, intrinsic, external and introjected. Sri Lankan boys also show a somewhat similar pattern, however, their introjected and external regulatory styles have the same mean values. In the Norwegian context when girls' and boys' regulatory styles are studied separately it differs from the country regulatory pattern. For Norwegian boys the regulatory styles when arranged in decreasing order are identified, intrinsic, extrinsic and introjected. The pattern for Norwegian girls was identified, extrinsic, introjected and intrinsic.

Table 5.2 Gender wise interpretation of results for Sri Lanka

	Boys (n=78)				**Girls (n=67)**			
	Mean	**SD**	**Count**	**%**	**Mean**	**SD**	**Count**	**%**
External regulation	2.89	.50	9	11.5	2.91	.52	5.5	8.2
Introjected regulation	2.89	.53	6	7.7	2.78	.60	3	4.5
Identified regulation	3.48	.49	53.5	68.6	3.65	.34	51.5	76.9
Intrinsic motivation	2.93	.60	9.5	12.2	2.96	.56	7	10.4
Relative autonomy index (RAI)	.68	1.89			.98	1.64		

Table 5.3 Gender wise interpretation of results for Norway

	Boys (n=78)				Girls (n=67)			
	Mean	**SD**	**Count**	**%**	**Mean**	**SD**	**Count**	**%**
External regulation	2.55	.53	10	12.8	2.67	.47	9.5	14.2
Introjected regulation	2.42	.56	3	3.9	2.66	.50	6.5	9.7
Identified regulation	3.23	.50	55	70.5	3.26	.50	45	67.2
Intrinsic motivation	2.70	.68	10	12.8	2.43	.74	6	8.9
Relative autonomy index (RAI)	1.11	2.07			.12	2.05		

The sub question of the first research question concerns whether there is a correlation between gender and motivation. Regression analysis was performed and the Pearson correlation coefficients show that there is no correlation between gender and motivation both is Sri Lankan and Norwegian samples.

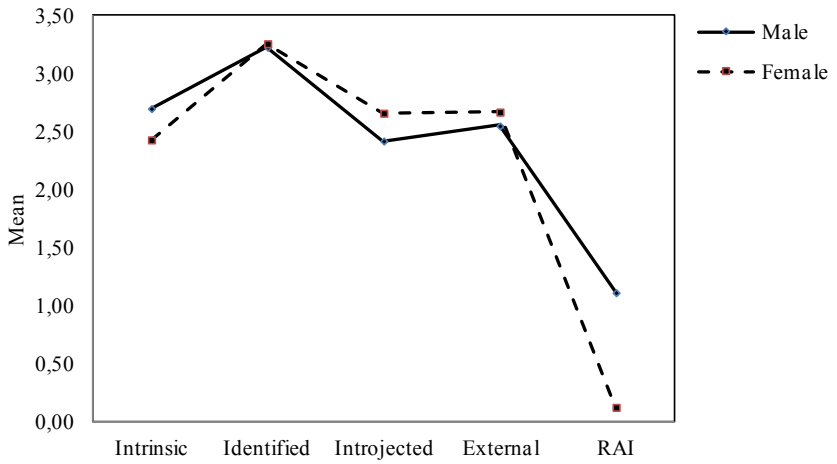


Figure 5.2 Regulatory styles of Norwegian male Vs female students

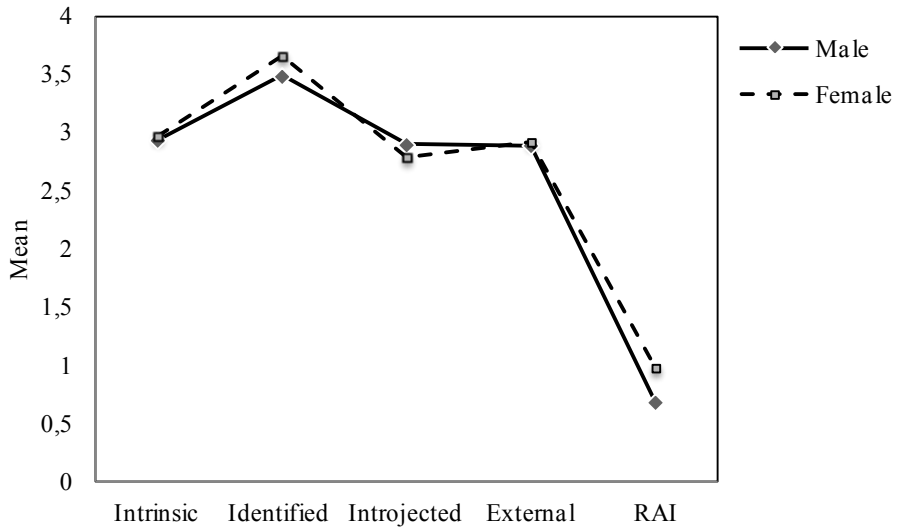


Figure 5.3 Regulatory styles of Sri Lankan male Vs female students

When the correlations between the variables are studied, conceptually close variables have higher correlations between them compared to the conceptually distal variables (Table 5.4, 5.5). In other words, the correlation between external and introjected variables is higher than the correlations between both external and identified and external and intrinsic. As stated in chapter 4, the highest correlations result along the diagonal providing evidence to the ordered structure of the self-determination continuum.

Table 5.4 Correlations between the academic self-regulation variables and RAI for Sri Lanka

	External	Introjected	Identified	Intrinsic
Introjected	.599(**)			
Identified	.213(*)	.242(**)		
Intrinsic	.146	.220(**)	.512(**)	
RAI	-.612(**)	-.455(**)	.383(**)	.629(**)

** Correlation is significant at 0.01 level (2-tailed)

* Correlation is significant at 0.05 level (2-tailed)

Table 5.5 Correlations between the academic self-regulation variables and RAI for Norway

	External	Introjected	Identified	Intrinsic
Introjected	.577(**)			
Identified	.313(**)	.448(**)		
Intrinsic	-,073	.193(*)	.605(**)	
RAI	-.599(**)	-.295(**)	.384(**)	.808(**)

** Correlation is significant at 0.01 level (2-tailed)

* Correlation is significant at 0.05 level (2-tailed)

There are significant correlations between intrinsic and identified pair of variables and external and introjected pair of variables.

5.1.2 Data analysis and results of part II of the questionnaire

The part II of the questionnaire collected data on the students' perceived competence, attitudes about science and their socio-economic status which would be helpful in discussing the results. In the Sri Lankan sample 32.4 percent had reported they would choose science subjects for A/L, 29.7 percent reported they would not and 37.9 percent had not decided yet. In the Norwegian sample 41.4 percent of students reported they would choose science subjects at upper secondary school, 24.1 percent reported they would not and 34.5 percent were not yet decided what they would choose. More Norwegian students reported their willingness to pursue science stream in upper secondary school compared to their Sri Lankan counterparts.

When studying the students' ambition to engage in a science related career in future, 41.4 percent of Sri Lankan students had admitted that they have an idea to pursue a science related career in future, 19.3 percent had answered they will not pursue a science related career while 39.3 percent had no idea whether they would select a science job in future or not. In the Norwegian context 29.1 percent of students had stated that they have an idea of choosing a science related career in future, 52.3 percent had stated they will not choose a science related career, 18.6 percent had no idea what they would do. When comparing the results, a higher percentage of Sri Lankan students demonstrated a willingness to pursue a science related career compared to their Norwegian counterparts. It is noteworthy that a higher percentage of Norwegian students had stated they would not select a science related career in future compared to the Sri Lankan counterparts while a higher percentage of Sri Lankan students had no idea what they would do compared to the Norwegian counterparts. Therefore it is

apparent that at this age, more Norwegian students have reported they would not pursue a science related career in future compared to the Sri Lankan counterparts. Data does not reveal whether it is strong dislike for science or a strong desire for some other non-science job that led to this result.

When requested to specifically name if they have any job that they are passionate to pursue in future, in the Sri Lankan context 37.9 percent of Sri Lankan students had named a specific science related career as the career they would like to choose in future while it is only 15.2 percent in the Norwegian sample. Therefore it is evident that more Sri Lankan students have a future goal of pursuing a science related career compared to their Norwegian counterparts. However, the student-reported data on their future aspirations and selecting science subjects at upper secondary school are not compatible. A higher number of Sri Lankan students demonstrated a desire to engage in a science related career compared to Norwegian students whereas a lower number of Sri Lankan students opted to choose science at upper secondary level. It was observed that some students reported they would choose a science related career in future and even named a specific job but reported they would not choose science for A/L. Lucrative jobs serve as external contingencies for Sri Lankan students displaying an external locus of causality with regard to their behaviour in science.

The Sri Lankan and Norwegian student samples are not comparable with regard to the social class. As mentioned in chapter 4, since seeking permission from schools to conduct the study was extremely difficult it was not pragmatic to select schools purposively with comparable socio-economic status. The majority of the Sri Lankan students who participated for the research have lower middle class family background. The highest academic qualification obtained by 46.9 percent of mothers was GCE O/L and 36.6 percent was GCE A/L. Only 6.2 percent of mothers had obtained university degrees. The highest academic qualification obtained by 37.9 percent of Sri Lankan fathers was GCE A/L and 46.2 percent was GCE O/L while only 5.5 percent were graduates.

On the other hand, majority of the Norwegian student sample represents either the upper middle or upper class. In the Norwegian sample 33.1 percent of fathers and 34.5 percent of mothers had received university education which is very high compared to the level of education of Sri Lankan parents in the sample. It is evident that the level of education of parents has a great impact on the education of children. More educated parents tend to motivate their children for higher academic goals.

In the Sri Lankan sample 48.3 percent of students reported their performance as average and the same portion (48.3 percent) of students as clever and 3.4 percent as very clever. In the Norwegian sample 31 percent of students reported their performance in science as average, 44.9 percent as clever and 24.1 percent as very clever. In comparison Norwegian students reported higher perceived competence in science than Sri Lankan students.

5.2 Qualitative data analysis

Qualitative data analysis answers the second research question of the study; how do the Sri Lankan and Norwegian students' perceptions about science learning reflect their basic psychological need satisfaction with respect to science learning? The postulate of fundamental psychological needs is the heart of SDT, no study of SDT can be complete without the study of the dynamics of fundamental psychological needs. As stated in chapter 4, semi structured interviews were conducted with students and teachers and the questions were designed to explore the basic psychological need satisfaction of students. The dependent variables that shaped the questions were autonomy, relatedness and competence.

In contrast to quantitative data analysis qualitative data analysis lack any hard and fast rules for analysis but are guided by some general steps. Coding the raw data, categorization of data depending on the codes, identifying themes/concepts, developing a theory are the sequential steps in a pure qualitative study with an inductive approach such as in grounded theory. In this mixed methods study the qualitative data analysis was deductive in nature that the researcher has been wearing the theoretical lens during the search for the buried treasure. The qualitative data analysis was primarily an exploration of the variables autonomy, relatedness and competence. As stated in Chapter 4, hypotheses coding was applied to the transcribed data. In this approach a list of codes was predetermined based on the SDT. The predetermined codes used in the first cycle of coding were, compliance, external rewards, ego involvement, personal importance, conscious valuing, empathy, self-initiation, self-concept, self-control, self-efficacy, acceptance, enjoyment, career, future, guilt, punishment, resilience, academic pressure, engagement, reliance, volition, parental involvement, interest, exploration, peer learning, elaboration, inherent satisfaction. In the second cycle of coding it is explored whether there are any patterns in the variables autonomy, relatedness and competence.

As the unit of analysis in this study is individual student, the interviews will be analyzed case by case and the codified data will be categorized in an exploration of a pattern to answer the research question.

5.2.1 Sri Lankan participants' data analysis

SL4M1

This student was very satisfied about the teaching style of the science teacher and appreciated the teacher. The student's responses displayed a good interpersonal relationship with the teacher. The student confidently responded that he would go unto his teacher if there's something he doesn't understand. The student has a career target to be a doctor. According to him, when he was in grade 6, 7 he did not have an ambition to be a doctor, but owing to her teacher's teaching style he has developed an ambition to become a doctor. Nevertheless being the only child in a lower middle class family, the student is also driven by the parents' dream of the only son becoming a doctor.

"*When I get marks they say it would have been better if I could get even more. My mother says it's better if I can be a specialist doctor after all I'm the only child in my family."*

In analyzing the level of internalization it can be concluded that he can be placed in the identified regulation category. He is not pressurized by the parents dream rather he is willingly studying science because he has identified the value of the self-selected goal. He displays a high perceived competence in science because his marks are within the "A" grade range as per the grading system in O/Ls. He categorized some of his peer students as weak students during the conversation whereby he indirectly referred to him as a clever student. The student perceived him as an effective individual in the classroom which showed the satisfaction of the relatedness need to a considerable extent. The conscious valuing of the external reward of engaging in a lucrative science related career has led to a development of instrumentality in the student that his behaviour can be seen as means to the end rather than an end in itself. The extra materials he uses are the past paper books which are helpful for him in exam preparation. He is in fact contented with the teacher because she corrects the past papers. The teaching-learning process exhibits exam orientation and the student is appreciative of the teacher as her teaching practices help him realize his dream. Despite the confidence he has on the science teacher he attends private tuition classes for science. As

revealed in the interview the student does not engage in curiosity based behaviour. He rarely discusses science related issues with his fellow students.

SL1M2

This student is studying science in English medium. He has very low perceived competence in science. He has no idea whether he would choose science for A/Ls or not. He has more reliance on the tuition teacher than on the school science teacher. If he has any doubts he will clarify them with the tuition teacher. The student does not study science daily but starts studying one month before the exam. He sometimes studies before going to the tuition class but never before school. He has given a prominent place to the tuition class and shows less sense of belongingness to the school science class. Although the student's parents do not force him to either choose science for A/Ls or find a science related career, the student believes it would be great if he could be an engineer.

SL3F1

The student reveals that she has lost the interest for science as the subject is getting harder. She had a great interest for science when she was in grade 6, 7 and she says that she even scored 90's and now she scores an average of 50. Her verbal and non-verbal communication revealed that she has very low perceived competence in science. She has comparatively positive attitudes about biology and highly negative attitudes about physics and chemistry. This student belonging to a lower class family does not receive much encouragement and persuasion from her parents apart from the fact that she is being sent to tuition classes. She does not have any future goals or ambitions but states that she prefers aesthetic subjects. She is not pressured by her parents meaning that she has a choice to select what she believes is the best for her. However in terms of science learning there is less autonomy as she has no control over her behaviour. When queried about the strategies she undertake when she lacks comprehension in a lesson she replies that she will not ask from the teacher, instead ask from either a friend or someone who knows.

"None of us ask from the teacher again even if we don't understand. We all are like that. We don't ask for the second time. No matter we understand or not we don't ask again. Certain things we understand in the first go. If we don't understand we try to understand it from the class. It's like that."

Even in the tuition class she says she will not ask the teacher for more explanation rather ask from a friend.

She does not study science daily because she has tuition classes in the afternoon and only completes her homework. She will study when the exam comes closer. She is a passive learner in the science class and does not engage in discussions with the teacher or peer students.

- SL3 classroom was a small classroom where it was difficult for the teacher even to move around the class. The space was not enough for the students to conduct proper group activities.

SL3F2

This student reveals she likes science little because she does not understand certain parts. When inquired whether she would select science stream for A/L, she firmly answered "No". She has a future goal to pursue Arts subjects in A/Ls and become a teacher. This student has low perceived competence as her marks are not in the upper range. Similar to the earlier case, this student also states that she liked science very much when she was in grade 6, 7 and then the interest declined gradually with the conceptual complexity. She admits that learning science is important for life but she is incapable of understanding the subject. The student also states that she will not turn to her teacher if she cannot understand the lesson and that she skips the sections she finds difficult. She is studying science together with a friend. The student lacks any spontaneity or curiosity to learn science which are indicators of intrinsic motivation. Even the science related books she borrows from the library are ones which are exclusively targeted for the exam. The social context is less supportive of her autonomy, relatedness and competence needs with regards to science learning. Her goal is to obtain an "A" for science in O/Ls thus displays goal-directed behaviour.

"I try my best to get an A. If I cannot get an A I can get a B."

SL1T

This teacher is a trained science teacher with 8 years of teaching experience. She manifested a sense of dissatisfaction with regards to students' motivation to learn science. She said that students are not much motivated to learn science and it is similar in other subjects also. She mentioned in a complaining tone that students do not raise questions in the class. The dilemma is whether her teaching is not promoting active engagement or students have become passive learners due to continued lack of interest originated from previous grades. Although it cannot be strictly concluded from the 20 minute interview, during the interview her remarks reflected that she is more of a controlling type teacher than an autonomy supportive teacher. She compared the present school with her previous school and said the previous school was better as the pass percentage in O/L is higher. Also, she was disappointed with the students' discipline saying that they are getting spoilt. Her relatedness to students with respect to science teaching did not seem very satisfactory.

She complained that it is difficult to implement student-centered teaching style and she sees time, class size, and the length of the syllabus as barriers to successful student-centered teaching. It appears that her autonomy need is not fully satisfied because she has less control over her teaching. She acknowledges that science should be taught in closer connection to the environment but has no proposal as to how it can be done. She seemed to be entangled in a rigid bureaucratic structure.

"Student-centered method of teaching is good. But it's difficult to do everything they prescribe in the teacher guide. Although it has to be student-centered due to some reasons it is not fully student-centered. Time, length of the syllabus, class size sometimes teacher cannot walk through desk rows. It's difficult to create opportunities in schools for that. There are lots of students. Then we'll have to build new halls. They are the drawbacks. Student-centered method is good only for brighter students. In that method we cannot give a note to the students. Smarter student will somehow manage but the weaker one will not even have a note."

She mentions that majority of the students need merely a good grade for science in O/Ls and nothing beyond and she further states that most of the parents also encourages students only to obtain good grades in O/Ls. The teacher is not contented with the amount of resources she has as a teacher.

SL3T

This teacher has eight years of teaching experience and she is generally satisfied with the students' motivation to learn science. When queried about the strategies she adopts to motivate students she says students like to answer questions and because of that she gives them question paper books. Also, she stated that all students like experiments. This unfolds the fact that students are more examination oriented and admires endeavours that help them obtain better grades in exams. Analyzing the information revealed during the interview it is apparent that the teacher is a controlling teacher because she trains the students to sit for an exam by shaping them towards a right answer and that she takes charge of the classroom activities.

"Girls are keener to learn science. In Grade 10 and 11 boys don't understand and because of that they try to make fun in the class. Some boys are shy to show that they are keen on learning. Girls are very keen and they show the books to me and show that they want to learn. Some boys even if they are interested and want to show me the book, don't like to do so because the other boys laugh at them. When I go to them and mark books I can understand that they get hold of what is taught. But in general they don't understand. Even now I gave them a task but they cannot simplify the maths sums. In both my classes there are 2 or 3 students who are troublesome and because of them it is difficult to control the rest of the class. I think they don't understand."

The few disengaged students in the class drives the teacher towards more controlling behavior. Also, in the 10^{th} grade these adolescents are more concerned about the peer remarks that boys are ashamed of displaying higher interest in learning because it is considered as a feminine move by the rest of the boys. This characterizes that majority of the students are not effectively related to their peers and teacher in terms of science learning and that students' relatedness needs are not fulfilled.

According to this teacher, the parents do not seem to encourage students as it ought to be, and they do not even participate in parents' meetings and do not bother to check whether the child is learning properly. It discloses the fact that the social contexts of most of the students do not sustain the relatedness need. The teacher states that the students hardly remember anything they learnt in the past when inquired about constructive learning. It depicts that the students

do not engage in deep conceptual learning which is a characteristic of intrinsic learning. Students are superficially learning to absorb the subject matter that are tested in the exam.

5.2.2 Norwegian participants' data analysis

N1M1

The student demonstrates very high internalization that he has integrated the value of science learning to self. He is learning science for the sake of the inherent satisfaction that he gains by learning science. He self-initiates behavior that are curiosity driven such as conducting simple experiments at home where he has a small chemistry lab to conduct experiments. He is in fact motivated by his teacher to try the experiments at home which symbolizes good interpersonal relationship between the teacher and the student as well as teacher's autonomy supportive nature. Furthermore, he describes that he has even met with accidents when conducting experiments on his own and those experiences deepened his interest in the subject. He volitionally engages in this behaviour for the sake of the inherent satisfaction and enjoyment that he gains by conducting the task. Engagement, spontaneity and the non-instrumental nature of his behaviour signifies intrinsic motivation.

This student comes from an upper class educated family and his grandfather who is a doctor is apparently his role model. Although he is determined to pursue science in upper secondary school he is uncertain whether he would choose a science related career in future or not. He states that during his childhood he had a dream to become a doctor but now he is more interested in economics owing to the inspiration by his father who is a banker. Therefore, his behaviour with respect to science learning is not to achieve any separable outcome neither it is directly associated with future time perspective. His parents generally encourage him to do well in school so that he would have many possibilities in future which reflect that he has control over his activities thus, satisfies the need for autonomy. This student is not worried about grades and states that one can get good grades when one is interested in the subject and that grades do come spontaneously. He describes that the reason for him to learn science is his genuine interest. The student particularly likes science as he can learn it through experiments and he explains he was happily surprised to when he came to the lower secondary school from the primary school because there are more facilities for experiments. He is fully confident

about his science teacher and would ask him if there are any doubts in science. He applies the scientific concepts he learn at school to real life contexts illustrating conceptual learning.

"We try to link them to everyday happenings very much. That's why I like science. Since I was a kid I have been curious and wondering why things are the way they are. And I think science gives very many explanations to these. In every science lesson I always get a new answer for something I have been wondering about. It's a very nice feeling to have, to feel you know something more."

He also states that he discusses these scientific phenomena with his friends signifying that he is effectively related to his peers with respect to science learning. This student exemplifies the satisfaction of all three autonomy, relatedness and competence needs, thus his behaviour is driven by self-determined intentional regulation. Both his family and science class provides him autonomy supportive, informational social contexts nurturing his intrinsically motivated behaviour.

N1F1

This student has a general interest in science but dislikes to sit in the class for long listening to the teacher as she does not understand due to her lack of knowledge of the terminologies. She enjoys the experiments and willingly engages in them. She is uncertain about the subjects she would choose in upper secondary school or the career she would choose in future. She believes being a doctor is an exciting profession but is unsure what she would do. She is not very effectively related to her peers and the teacher with respect to science learning. If she comes across complicated subject matter she will ask from the teacher at school but if she similar while doing her homework she will not bring them to the class and ask from the teacher. In such instances she will search online because reading subject books is boring for her. She is worries about the grades quite a lot and displays exam-oriented behaviour. She says she would strive hard if she gets lower grades. She says the terminologies in science are difficult for her to remember and that science is not her favourite subject. The interview reveals that she is not deeply engaged in the subject as she does not engage in any curiosity driven behaviour. Also she displays very low level of application of science knowledge to real life situations and such matters have never become topics of her conversations with her friends. Her parents do not force her for anything and allow her to pursue her ambitions. She

has a sister who is a science undergraduate. She lacks persistence when engaging in science lessons and easily gets bored. This student has a good perceived competence.

N1M2

This student likes to learn science but has a low perceived competence in science. When queried whether he would select science in upper secondary school he responds that he is not that good but can keep up with the lessons that are being taught now. He has low self-efficacy in the science domain. He does not have a specific career in mind and he does not experience any pressure from the parents as to what he should study or what he would do in future. They want him to learn as much as possible. He enjoys the experiments and finds the science class amusing. He speaks very positively about the way science is being taught at school. In an instance where he needs extra explanation he would not turn to his teacher or friends instead he would check it in the Internet. When inquired the reason for him to do his science homework he replies,

"It's for me to learn, I don't want to lag behind in what everybody else knows."

This statement signifies the ego involvement in behavior where the student experiences internal pressure to learn. His self-esteem is contingent on his behavior and this is exemplary of introjected regulation. He is satisfied with the support he receives from his teacher and says there is sufficient opportunity for discussion in the class.

N1F2

This student is determined that she will not engage in a science related career in future though she has an idea to select science at upper secondary school. Her ambition is to pursue a career in media. She comes from an upper class family and her elder brother has chosen science at upper secondary school. The student discloses that she lost the interest for science when she came to upper grades as the level gets higher. She has been very interested in science when she was in lower grades. The reason for her to learn science is because it is a compulsory subject and the prominent reason for her to do her homework is because the teacher tells her. She has an average perceived competence about her ability in science.

"I'm kind of in the middle. I study for tests but in the class I'm not so good."

She is not persistent in science learning that her behaviour in science is stimulated by the exam. This characterizes that external regulation determines her behavior and that she is instrumentally focused. She will ask from the teacher if there is anything she does not understand. She is fairly satisfied about the way science is taught at school. The interview reveals that she is not deeply engaged in science or she enjoys science learning. She will study science for the tests because she would like to have good grades but science learning has not been fully internalized to self. She conducts experiments at home when she is given such tasks as homework.

N1T

This teacher has ten years of experience as a teacher. Analysis of his interview reveals that he possesses more elements of an autonomy supportive teacher than a controlling teacher. He believes that students should be intrinsically motivated not extrinsically.

"Parents in general push them to get good grades. We don't like it. It should be inner motivation. Some get money from the parents when they get good grades, they are pretty much spoilt. But they are pretty much motivated because their parents are good at education."

It is evident that monetary rewards are detrimental to intrinsic motivation. This statement signifies that some parents unknowingly foster extrinsically motivated behaviour among students. The relationship between students' performance and the parents' level of education is well documented in literature. Since the level of education of parents in this school is high the students' social contexts motivate them towards good performance in school. The teacher attempts to foster the inquisitiveness of students by stimulating their innate curiosity for exploration. His strategy is to make students active in learning by employing a varied mix of teaching methods and creating ample opportunity for communication. When queried how he motivates students he describes that sitting too much with the books, learning theory can diminish the interest of students and therefore more diverse learning activities should be incorporated which enables them to experience the theory they learn. His explanation reflects that he provides optimal challenges for students and is a source of stimulation for students demonstrating elements of an autonomy supportive teacher.

N2T

This teacher has two years of teaching experience. His conception regarding the strategies to motivate students is that combining varied teaching methods in the classroom. The interview reveals elements that would support him to be portrayed as an autonomy-supportive teacher. He believes that more learning occurs when student takes the initiative. The teacher stated that the degree to which parents motivate children depends on their background and he specifically mentioned the term "cultural background" revealing his experience as a teacher in a multicultural school.

5.2.3 Results from the qualitative analyses

In analyzing the qualitative results, individual differences and cultural differences come in to play. The fundamental psychological need fulfillment is subjective and it is very complex to draw causal relationships. This is in fact a problem faced by motivation researchers. However, it was evident that intra cohort differences were minimal. In other words, Sri Lankan students shared more or less some common problems and the analyses between Sri Lankan students did not vary significantly. It is the same with Norwegian students also. Norwegian students' data analyses did not differ significantly between each other. There were distinct differences between the two countries but not within country or between genders. Therefore following interpretations are made in comparative terms.

Norwegian students' autonomy need satisfaction is high compared to Sri Lankan students. In Sri Lanka students experience high evaluative pressure due to the severe competition and this is detrimental to the students' sense of autonomy. Majority of Sri Lankan respondents study science because it is a compulsory subject. In both countries students stated that their parents do not pressure them to select science in upper secondary school or engage in a science related career in future.

Sri Lankan students demonstrate low perceived competence, thus the need for competence is not fully satisfied compared to their Norwegian counterparts. They show low self-efficacy and self-concept in science learning. In evaluating student performance, marks or grades are used as indicators of student ability. This finding is consistent with Wannigama's study where he underscores the influence of academic achievement measures on the formation of self-concept of academic ability among Sri Lankan students (Wannigama, 2005). Generally

speaking in both countries, marks do contribute tremendously in shaping students' self-efficacy in a given subject. Students do not consider the effort they put in for preparation but consider marks merely as a function of their ability. There was one exceptional case in Norway who had high perceived competence and viewed marks as a function of both the ability and preparation for the test. According to him the marks can be low if he could not prepare for the test sufficiently but his perceptions of competence did not change with marks. In the Sri Lankan context, due to the examination-oriented nature not only students but also parents and teachers are overly concerned about marks and since they attribute marks to the ability level of the student, marks determine the self-efficacy of Sri Lankan students.

The relatedness need of Norwegian students is satisfied more compared to the Sri Lankan students. Sri Lankan students are not very open in the learning process unlike Norwegian students. In the collectivist culture prevailing in Sri Lanka which has roots in the Buddhist and Hindu traditions, children are trained to respect and obey elders and not to question them. Teachers are highly respected and teaching profession has been bestowed a noble place in the society. Schools as social institutions successfully pass these cultural norms to the younger generations. Students respect and obey teachers and they are strongly attached to the teachers but the dynamics of the teacher-student relationship do not produce enough dialogue in the classroom. According to the students they have been accustomed to be passive listeners from lower grades.

Another factor which significantly contributes to this phenomenon is the age of these students. These students are in their adolescence which is a unique developmental stage during which they undergo hormonal changes leading to physical, mental and emotional transformations. They are overly concerned about peer remarks and are keener on engaging in behaviour that would attract the attention of peers and refrain from engaging in behaviour which would possibly lead to humiliation by peers. Since all four Sri Lankan schools are mixed schools students are particularly concerned not to be the subject of humiliation and be embarrassed especially in front of opposite sex students. They fear that if they receive a negative feedback from the teacher peer students will attribute it to their incompetence and ignorance and as a result they are very careful when asking questions. This universal phenomenon is common to Norwegian adolescents also; however, due to the individualistic culture they are comparatively more open. They respect the teacher and treat teachers as

human beings and open up to raise questions whenever they feel it is necessary. Norwegian students manifested less anxiety and shyness with regards to participation in the lesson.

According to the data gathered from all four Sri Lankan schools, the school cultures target at producing good results and train students to cram and obtain higher grades at the national level exams. The learning environment generates evaluative pressure on the learner. The school cultures of the three Norwegian schools are not exclusively examination-oriented. They create more relaxed learning environments which facilitate intrinsic motivation. Interviews revealed that Norwegian students are more independent compared to Sri Lankan students which can be attributed to the individualistic culture Norwegian students have been brought up. Sri Lankan students who are brought up in a collectivist culture are dependent on each other and relationships are of prime importance to them.

Sri Lankan students greatly rely on private tuition for science learning compared to the Norwegian counterparts. Almost all Sri Lankan respondents receive private tuition for science whereas none of the Norwegian respondents receive any form of extra help with respect to science learning. When private tuition comes to picture it brings in instrumental learning. The prime purpose of a tuition teacher is to improve the performance of the learner in terms of better grades rather than making the learner intrinsically motivated.

In both countries students and teachers revealed that even though the subject matter gets complex, by incorporating more experimental work students' interest in the subject can be nurtured. Also, it was revealed that relevance of science to their everyday life especially to health, makes science interesting for the learner. Students preferred to learn biology not only because the subject matter was comparatively less complex but also because they could see a direct relevance of what they learn to their lives. Norwegian teachers underscored the importance of incorporating a varied mix of teaching methods to sustain students' enthusiasm in the lesson. Norwegian teachers are more autonomy supportive than Sri Lankan teachers. Also, Sri Lankan teachers manifested more dissatisfaction and frustration about teaching compared to Norwegian teachers.

6 Discussion

In this chapter first the results obtained from the quantitative and qualitative segments of this mixed methods research will be reviewed and will be synthesized to obtain the final interpretation. Secondly the final interpretation will be discussed in terms of the pedagogical and socio-cultural differences between the two countries.

The first research question which guided this study was; What is the motivation pattern for science learning among Sri Lankan and Norwegian 10^{th} graders, as measured by SRQ-A? As the quantitative data suggests, both Sri Lankan and Norwegian students are extrinsically motivated to learn science. However, their behaviour is determined by identified regulation which is the most internalized form of extrinsic motivation measured by SRQ-A. The positive RAI values obtained for both countries indicate autonomous motivation, thus somewhat internal perceived locus of causality. Identified regulation is an autonomous motivation form and it is evident that more autonomous styles of extrinsic motivation enhances student learning. Although Sri Lankan students had a numerically higher RAI value than Norwegian students, there was no statistically significant difference between the RAI values of the two countries. This answers the first research question of the study.

The sub-question of the first research question concerns whether there is a correlation between gender and motivation. It was revealed that there is no correlation between gender and motivation in both countries. This is quite interesting concerning the cultural differences in the two countries.

The second research question, *how do the Sri Lankan and Norwegian students' perceptions about science learning reflect their basic psychological need satisfaction with respect to science learning?* was answered by the qualitative results. Through the qualitative results it was revealed that the basic psychological needs of Norwegian students are satisfied more compared to the Sri Lankan students. The sample size of the quantitative strand is significantly higher than the sample size in qualitative strand. A vast majority of the studies conducted on basic psychological needs fulfillment using SDT as the theoretical perspective have opted for quantitative strategy. As stated before it was not feasible to incorporate two questionnaires within the scope of this study. In the quantitative segment of the study data was collected on the students' perceptions about their competence in science. As stated in

chapter 5, Norwegian students reported higher perceived competence in science. This is consistent with the qualitative results regarding students' perceptions of competence. Therefore the findings can be merged to reach a solid conclusion that the Norwegian students demonstrate higher perceived competence in science than Sri Lankan students. The second part of the questionnaire could not be lengthened as the time for completion would be lengthened leading to pragmatic issues. Therefore, the questionnaire did not include items on students' perceptions on autonomy and relatedness. If such items could be incorporated mutually illuminating quantitative and qualitative data could be gathered.

The student and teacher interviews revealed that Norwegian students get more opportunities to conduct experiments than Sri Lankan students. This can be one reason for their high perceived competence in science. "Learning by doing" is crucial in the learning mechanism of practical subjects like science where the learner gets the opportunity to experience things and learn by trial and error. In the current Sri Lankan examination system neither GCE O/L nor GCE A/Ls have a practical component. Although practicals are conducted in schools, due to the extreme examination-oriented nature practicals are not given a prominent place in science learning. Especially in the 10^{th} grade level students rarely get the chance to conduct individual experiments. In the Norwegian context, students revealed that they sometimes conduct experiments on their own. This not only enhances the perceptions of competence but also enhances the sense of autonomy. Group practicals can enhance the sense of relatedness in students when they interact and learn from each other. However, when the aptitudes of students significantly differ, group dynamics can lead to thwarting of the basic psychological needs of weak students when dominant students take the lead. Norwegian students do not have a written science exam in the centrally conducted lower secondary school examination. It is evident that Norwegian students undergo less evaluative pressure than Sri Lankan students.

When discussing the quantitative and qualitative results a slight contradiction occurs. If Sri Lankan students are more motivated to learn science as the RAI value suggests, according to the SDT, their basic psychological needs fulfillment should be higher than that of Norwegian students. As per the qualitative results Sri Lankan students demonstrated lower basic psychological needs fulfillment than Norwegian students. However, statistically speaking, there is no significant difference between the RAI values obtained for Sri Lanka and Norway. Therefore, it is apparent that Norwegian students are comparatively better in terms of their

basic psychological need satisfaction and have more potential than Sri Lankan students in engaging in behaviour caused by internal locus of causality. More importantly, the interpretations should be done with caution. The results cannot be generalized to country level and it is identified as a limitation of this study. Random sampling could not be conducted due to pragmatic issues and non probability sampling was conducted and consequently the sample was not sufficiently representative of the whole country situation. The study was conducted in the capital city of each country and in any country a sample drawn from the capital does not substantially represent the country level situation.

The Sri Lankan and Norwegian samples are not comparable with regard to the socio-economic status of students' families. The Norwegian students' participated in the study had more educated parents compared to Sri Lankan students. More educated parents persuade their children to do well in studies and they are capable of creating a secure social, financial environment where students can progress in learning. According to student revelations Norwegian parents do not pressure them for specific future career goals, instead encourage students to perform well in studies and have several possibilities concerning future career. Sri Lankan parents also give freedom to their children to choose the subject stream they prefer for A/Ls but they are keen to see their children becoming doctors or engineers. There is no encouragement by parents to have several different qualifications to be able to have a flexible career life and encounter any uncertainties. This difference can be understood in light of the economical, social and cultural differences between the two countries.

The qualitative data suggests that the autonomy need of Sri Lankan students is not satisfied to the extent it is satisfied in Norwegian students. However, in the Sri Lankan context no studies have been conducted on the need for autonomy in the learning context. Although SDT claims autonomy need to be universal some studies have questioned the universality of autonomy especially in collectivist oriented societies. However, in the Norwegian context there are empirical evidence to support the relationship between basic psychological need satisfaction (autonomy support) and academic achievement (Diseth & Samdal, 2014; Jeno & Diseth, 2014).

The qualitative data reveals the tremendous impact of the examination-oriented nature in the Sri Lankan education system on determining the classroom climate which in turn determines the basic psychological need satisfaction in students. This indeed is detrimental to inculcating intrinsically motivated behavior in students. The 5E instructional model focuses on student-

centered activities and theoretically it has the capacity to give the student a full sense of volition and choice. Unfortunately, it was revealed that the 5E instructional model is not exactly in practice. This provides support to the findings by Egodawatte and Perera (Egodawatte, 2014; Perera, 2009). Teachers view class size, the aptitude of students, lengthy curriculum, lack of resources as barriers to practice 5E instructional model. These findings are consistent with findings from Jayawardena's study (Jayawardena *et al*., 2016) where they revealed that overloaded curriculum and lack of resources are barriers to the implementation of the curriculum. Although it has been nearly two decades since the introduction of student-centered curriculum and 5E instructional model, it was apparent that the pedagogical practice of most teachers lies in between teacher- centered and student-centered pedagogy. A hybrid variety of the 5E model is in practice and it creates less opportunity for student-initiated learning. In Sri Lanka it is evident that the curriculum and pedagogy act as barriers to fulfilling the basic psychological needs of students and producing intrinsically motivated learners. In contrary, due to adapted learning practiced in Norway, the learning environment is comparatively more autonomy-supportive and provides a sense of volition and choice to the student.

In Sri Lankan schools the average class size is higher than that in Norway. The number of students in schools located in population dense urban cities is very high compared to those in remote areas. In some of these remote schools such as plantation schools multigrade teaching take place. In Norway also there is a similar situation. Multigrade teaching takes place in population scarce remote areas. However, as observed from field visits, Norwegian schools possess significantly more physical resources than Sri Lankan schools. Even in urban schools though the class size is high, the physical size of the classroom is sufficient to accommodate students. In some Sri Lankan schools participated in the study, the students were squeezed in to a small space. Not only the social, intellectual environment but also the physical environment has a significant impact in creating a satisfactory learning environment which enhance the motivation to learn.

In Sri Lanka, due to the widening income inequality, education has become the ladder to upward social mobility for the lower and middle classes. Due to the limited opportunities for state funded higher education in public universities, a severe competition has created among students and parents. As described in chapter 2, there are vast differences in the economies and the allocation of resources for education (Table 2.1). Norway being an affluent nation

provides ample opportunities for those who opt to continue their studies. It is evident that Sri Lankan students strive hard to do well in science.

The role of private tuition in the Sri Lankan context was alarming. Students were dependent on tuition more and more as they progress to upper grades. Results showed that even students from lower income families were sent to tuition which underscored that tuition has risen to the top in the priority list of an average man. Students were not confident that the knowledge and skills they receive from school is sufficient for their best performance in the exam. Thus, they opt to seek private tuition and it is apparent that seeking tuition has been established as a trend due to the demands of the social environment for example peer influence. Private tuition has negatively affected the relationship between student and the teacher. In instances where a student is exposed to difficult conceptual matter they rather become reserved learners by not speaking openly about the problems because they think it can be learnt from the tuition class. Teachers complain that the students do not raise questions during lessons and this lack of communication between the two parties affect the sense of relatedness in students. Private tuition stands as a barrier between the student and the teacher.

On the other hand qualitative data revealed that even private tuition classes were not creating learning climates where self-determined learning is nurtured. Instead they were reinforcing rote-learning. Some students when they are exposed to the same difficult conceptual matter at the tuition class, displays the same reserved behaviour and move on without thoroughly understanding the lesson. In contrary, private tuition does not stand as a barrier between the Norwegian student and the teacher. Although private tuition is becoming popular in Norway in the form of homework help especially in maths and science, it is in its infancy compared to the Sri Lankan context. Norwegian education system emphasizes that all should receive quality education and rather fears that proliferation of private tuition will deteriorate the quality of school education.

Students from both countries revealed alike that they loved to learn science until sixth or seventh grade and then when the subject became difficult they lost the interest. It is evident that competency-related attitudes negatively change during adolescence. As the subject becomes difficult it is challenging for science teachers to promote intrinsic motivation as majority of students become resistant to engage in deep conceptual learning which requires higher cognitive and meta cognitive skills. In such instances reinforcing extrinsically motivated behaviours seem more practical as the ultimate goal is leaning to occur. The

internalization of extrinsic motivation is important in occasions where the subject matter is not inherently enjoyable. As the results suggest both countries have been successful in internalizing extrinsic motivation with regards to science learning.

When comparing the teachers' orientation in the two countries it is evident that the Sri Lankan teachers show more controlling orientation and Norwegian teachers show more autonomy supportive orientation. The Sri Lankan teachers have become more controlling due to the demands made by the social environment. The educational authorities and parents exert pressure on them to produce good results which are measured by the number of "A" grades or pass percentage. This supports the findings of Kasturi Arachchi and Edirisinghe where they revealed that majority of Sri Lankan government school teachers are dissatisfied with lack of work autonomy and job security (Kasturi Arachchi & Edirisinghe, 2011). Norwegian teachers compared to the Sri Lankan teachers manifested to enjoy more work autonomy due to the less bureaucratic and rigid system. The teachers' need for autonomy is sustained to a comparatively lesser extent in the Sri Lankan context. Studying the teachers' basic psychological need satisfaction was not an aim of the study. However, it can be argued that if the teachers' basic psychological needs are not satisfied with respect to science teaching, how they can create learning climates that satisfy students' basic psychological needs. Since it has been found that teacher's controlling orientation affect students' intrinsic motivation as well as their self-concept in the subject (Valås & Søvik, 1993), this finding shows that Norwegian students could be intrinsically motivated.

As the Norwegian classroom is multiethnic and multicultural Norwegian science teachers face more challenges than Sri Lankan science teachers in satisfying the basic psychological needs. It was revealed that the parents' encouragement differs depending on the ethnic and cultural backgrounds. This study was not aimed at studying the differences in motivation among ethnic majority and minority students. However, as stated earlier, there is research evidence that ethnic minority students are more responsive when extrinsically motivated than ethnic majority students (Elstad & Turmo, 2009).

Although gender wise comparisons were not an aim of this study, dissecting the sample in to subgroups based on gender has shown that Sri Lankan girls are more autonomously motivated than Sri Lankan boys. These results cannot be compared with the qualitative interview results because of the significant difference in the sample size. However this is consistent with the motivation for science education among girls in Sri Lanka which is signified by the female

science graduates outnumbering male science graduates. In Norway boys were more autonomously motivated for science learning than girls. Elstad and colleague showed that academic pressure could stimulate Norwegian girls in critical thinking in science than boys (Elstad & Turmo, 2009). However, most studies have shown that girls perform better in science and are more motivated for learning than boys. Nevertheless in both countries students did not have any gender stereotyped attitudes regarding gender and performance in science. It is well-documented in literature that males are more motivated in “hard science” subjects such as physics and engineering and females are more motivated in “soft science” disciplines such as biology and medicine. This is in fact a universal phenomenon which is true for all countries across the globe.

There are many challenges encountered by researchers dealing with motivation. As Dörnyei (2001) points out motivation is abstract and not directly observable. In many of their field and laboratory experiments Deci and Ryan have used the length of task involvement as the indicator of motivation. It is difficult to measure complex psychological constructs like motivation with high reliability and validity. Motivation is a multidimensional construct and it is inconstant. Motivation differs with time and this fluctuation can be attributed to the variations in basic psychological needs satisfaction especially at the situation level.

7 Conclusion

The study was an exploration of Sri Lankan and Norwegian secondary students' motivation patterns in relation to science learning. It can be concluded that both Sri Lankan and Norwegian students are extrinsically motivated to learn science. The most prevalent regulatory style among both countries is identified motivation. There is no statistically significant difference between the RAI values of the two countries ($p>0.05$). Thus, both Sri Lankan and Norwegian students are equally motivated in learning science.

There is no correlation between gender and motivation considering both samples. Also, in both countries students did not have any gender stereotyped views about science. It is interesting to see that though males outnumber females in science related careers at 15 years of age, they do not relate science with gender.

It can be concluded that Norwegian students' basic psychological needs are satisfied more than that of Sri Lankan students with regards to science learning. Pedagogical and socio-cultural differences between the two countries contribute to this discrepancy.

8 Limitations of the study and directions for future research

Concerning the sampling technique, probability sampling was beyond the scope of the study due to pragmatic issues as described in Chapter 4. Therefore the study utilized a non-probability sampling technique, thus, generalizability of the findings to country level becomes a limitation of the study. Hence, the conclusion will be valid for the respective research populations rather than for Sri Lankan and Norwegian secondary level or 10^{th} grade student populations. Future research which can be conducted employing probability sampling, covering the entire country will produce valuable findings which can possibly differ from the findings of this study and will perhaps reveal the individualistic and collectivistic cultural differences that give rise to the differences in students' motivation.

Conducting a pilot study was beyond the scope of this study due to the difficulty in accessing schools and the time constraint. The original Self Regulation Questionnaire -Academic (SRQ-A) was translated to Sinhalese and Norwegian and were used in the study without conducting a pilot study. This is identified as a limitation of the study. The Sri Lankan students were not familiar with the stem question format in the questionnaire and as a result the instructions had to be repeated to several students. This could have been avoided by the use of a pilot study. Nevertheless, Norwegian students did not display such ambiguities.

The SRQ-A measures only four types of internalizations which are external, introjected, identified and intrinsic. It does not measure amotivation which is the lack of motivation to act. Therefore it is assumed that all students in both samples are either extrinsically or intrinsically motivated. Future research can focus on modifying SRQ-A by incorporating amotivation subscale also.

In a study exploring students' self-regulation in science learning, all student related factors associated with pedagogy, teachers, parent should be considered in light of the theoretical framework. Nevertheless exploring how the parental involvement contributes to students' regulatory styles could not be investigated due to the limited scope of the study, thus becomes a limitation of the study. Future research can incorporate this aspect to conduct more thorough analyses.

It is important that the psychometric properties of the instrument are measured so that the results obtained from the particular instrument can be used in meaningful interpretations. Validity, reliability, comparability and fairness are the psychometric properties that should be present in a high-quality research instrument. Since the original questionnaire is translated in to two languages and the results are used for comparisons, it is very important that the above psychological properties are present in the translated versions. Items in the translated questionnaire should only discriminate students based on the latent trait measured (motivation) but not disadvantage certain subgroups depending on personal attributes like gender and ethnicity. Especially when interpreting differences between subgroups concerning a subscale it is very important that measurement equivalence exists across subgroups. Comparison of subgroups based on RAI scores requires that RAI measures the latent trait motivation. In future research Differential item functioning (DIF) analyses can be conducted for the Norwegian and Sinhalese versions of SRQ-A. DIF analyses of the translated Sinhala and Norwegian questionnaires will identify whether there are any items that affect the fairness of the measurement. This will indeed enhance the utility of these questionnaires.

Another possible limitation of this study is researcher bias. Researcher bias is a common problem encountered by researchers and it comes in to play when qualitative data are involved. As the researcher has in depth knowledge in the Sri Lankan system and comparatively less knowledge about the Norwegian system, there is a possibility that certain interpretations are biased.

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Appendices

Appendix I: Questionnaires

A. SRQ-A (Academic) Original

The Scale (standard version)

WHY I DO THINGS

Name: _____ Age: _____

Grade: _____ ( ) Boy or Girl ( ) Teacher: _____

A. Why do I do my homework?

1. Because I want the teacher to think I'm a good student.

Very true Sort of true Not very true Not at all true

2. Because I'll get in trouble if I don't.

Very true Sort of true Not very true Not at all true

3. Because it's fun.

Very true Sort of true Not very true Not at all true

4. Because I will feel bad about myself if I don't do it.

Very true Sort of true Not very true Not at all true

5. Because I want to understand the subject.

Very true Sort of true Not very true Not at all true

6. Because that's what I'm supposed to do.

Very true Sort of true Not very true Not at all true

7. Because I enjoy doing my homework.

Very true Sort of true Not very true Not at all true

8. Because it's important to me to do my homework.

Very true Sort of true Not very true Not at all true

B. Why do I work on my classwork?

9. So that the teacher won't yell at me.

Very true Sort of true Not very true Not at all true

10. Because I want the teacher to think I'm a good student.

Very true Sort of true Not very true Not at all true

11. Because I want to learn new things.

Very true Sort of true Not very true Not at all true

12. Because I'll be ashamed of myself if it didn't get done.

Very true Sort of true Not very true Not at all true

13. Because it's fun.

Very true Sort of true Not very true Not at all true

14. Because that's the rule.

Very true Sort of true Not very true Not at all true

15. Because I enjoy doing my classwork.

Very true Sort of true Not very true Not at all true

16. Because it's important to me to work on my classwork.

Very true Sort of true Not very true Not at all true

C. Why do I try to answer hard questions in class?

17. Because I want the other students to think I'm smart.

Very true Sort of true Not very true Not at all true

18. Because I feel ashamed of myself when I don't try.

Very true Sort of true Not very true Not at all true

19. Because I enjoy answering hard questions.

Very true Sort of true Not very true Not at all true

20. Because that's what I'm supposed to do.

Very true Sort of true Not very true Not at all true

21. To find out if I'm right or wrong.

Very true Sort of true Not very true Not at all true

22. Because it's fun to answer hard questions.

Very true Sort of true Not very true Not at all true

23. Because it's important to me to try to answer hard questions in class.

Very true Sort of true Not very true Not at all true

24. Because I want the teacher to say nice things about me.

Very true Sort of true Not very true Not at all true

D. Why do I try to do well in school?

25. Because that's what I'm supposed to do.

Very true Sort of true Not very true Not at all true

26. So my teachers will think I'm a good student

Very true Sort of true Not very true Not at all true

27. Because I enjoy doing my school work well.

Very true Sort of true Not very true Not at all true

28. Because I will get in trouble if I don't do well.

Very true Sort of true Not very true Not at all true

29. Because I'll feel really bad about myself if I don't do well.

Very true Sort of true Not very true Not at all true

30. Because it's important to me to try to do well in school.

Very true Sort of true Not very true Not at all true

31. Because I will feel really proud of myself if I do well.

Very true Sort of true Not very true Not at all true

32. Because I might get a reward if I do well.

Very true Sort of true Not very true Not at all true

Scoring the SRQ-A (standard version). First, you calculate the subscale score for each of the four subscales by averaging the items that make up that subscale. Very true is scored 4; Sort of true is scored 3; Not very true is scored 2; and Not at all true is scored 1. The four subscales are: external regulation, introjected regulation, identified regulation, and intrinsic motivation. Listed below are the item numbers associated with each of the four subscales.

External Regulation: 2, 6, 9, 14, 20, 24, 25, 28, 32
Introjected Regulation: 1, 4, 10, 12, 17, 18, 26, 29, 31
Identified Regulation: 5, 8, 11, 16, 21, 23, 30
Intrinsic Motivation: 3, 7, 13, 15, 19, 22, 27

You can use the individual subscale scores in your analyses, and you can also use the Relative Autonomy Index (RAI). To form the RAI for this scale, use the following formula to combine the subscale scores:

2 X Intrinsic + Identified - Introjected - 2 X External

* * * * * * * * * * *

Appendix I: Questionnaires

B: Questionnaire (Norwegian translation)

Spørreskjema

Del I: Hvorfor jeg arbeider i naturfag?

Vennligst strek under svaret som du er mest enig i

A. Hvorfor gjør jeg naturfag lekser?

1. Fordi jeg ønsker at læreren skal tro at jeg er en god elev

Veldig sant Litt sant Ikke veldig sant Ikke sant

2 . Fordi jeg får problemer hvis jeg ikke gjør det

Veldig sant Litt sant Ikke veldig sant ikke sant

3 . Fordi det er gøy

Veldig sant Litt sant Ikke veldig sant ikke sant

4 . Fordi jeg vil få dårlig samvittighet hvis jeg ikke gjør det

Veldig sant Litt sant Ikke veldig sant ikke sant

5 . Fordi jeg ønsker å forstå faget

Veldig sant Litt sant Ikke veldig sant ikke sant

6 . Fordi det er det jeg skal gjøre

Veldig sant Litt sant Ikke veldig sant ikke sant

7 . Fordi jeg liker å gjøre naturfaglekser

Veldig sant Litt sant Ikke veldig sant ikke sant

8 . Fordi det er viktig for meg å gjøre naturfaglekser

Veldig sant Litt sant Ikke veldig sant ikke sant

B. **Hvorfor jobber jeg med naturfag på skolen?**

9. Slik at læreren ikke vil kjefte på meg

Veldig sant Litt sant Ikke veldig sant ikke sant

10. Fordi jeg ønsker at læreren skal tro at jeg er en god elev

Veldig sant Litt sant Ikke veldig sant ikke sant

11. Fordi jeg ønsker å lære nye ting

Veldig sant Litt sant Ikke veldig sant ikke sant

12. Fordi jeg skammer meg hvis det ikke blir gjort

Veldig sant Litt sant Ikke veldig sant ikke sant

13. Fordi det er gøy

Veldig sant Litt sant Ikke veldig sant ikke sant

14. Fordi det er regelen

Veldig sant Litt sant Ikke veldig sant ikke sant

15. Fordi jeg liker å gjøre naturfag på skolen

Veldig sant Litt sant Ikke veldig sant ikke sant

16. Fordi det er viktig for meg å jobbe med naturfag på skolen

Veldig sant Litt sant Ikke veldig sant ikke sant

C. **Hvorfor prøver jeg å svare på vanskelige spørsmål i naturfag?**

17. Fordi jeg vil at de andre elevene til å tro at jeg er smart

Veldig sant Litt sant Ikke veldig sant ikke sant

18. Fordi jeg skammer meg når jeg ikke prøver

Veldig sant Litt sant Ikke veldig sant ikke sant

19. Fordi jeg liker å svare på vanskelige spørsmål

Veldig sant Litt sant Ikke veldig sant ikke sant

20. Fordi det er det jeg skal gjøre

Veldig sant Litt sant Ikke veldig sant ikke sant

21. For å finne ut om jeg har rett eller galt

Veldig sant Litt sant Ikke veldig sant ikke sant

22. Fordi det er gøy å svare på vanskelige spørsmål

Veldig sant Litt sant Ikke veldig sant ikke sant

23. Fordi det er viktig for meg å prøve å svare på vanskelige spørsmål i klassen

Veldig sant Litt sant Ikke veldig sant ikke sant

24. Fordi jeg vil at læreren skal si fine ting om meg

Veldig sant Litt sant Ikke veldig sant ikke sant

D. **Hvorfor prøver jeg å gjøre det bra i naturfag?**

25. Fordi det er det jeg skal gjøre

Veldig sant Litt sant Ikke veldig sant ikke sant

26. Så lærerne mine skal synes at jeg er en god elev

Veldig sant Litt sant Ikke veldig sant ikke sant

27. Fordi jeg liker å gjøre naturfag skolearbeid

Veldig sant Litt sant Ikke veldig sant ikke sant

28. Fordi jeg vil få problemer hvis jeg ikke gjør det bra

Veldig sant Litt sant Ikke veldig sant ikke sant

29. Fordi jeg får dårlig samvttighet hvis jeg ikke gjør det bra

Veldig sant Litt sant Ikke veldig sant ikke sant

30. Fordi det er viktig for meg å prøve å gjøre det bra i naturfag

Veldig sant Litt sant Ikke veldig sant ikke sant

31. Fordi jeg vil bli stolt av meg selv hvis jeg gjør det bra

Veldig sant Litt sant Ikke veldig sant ikke sant

32. Fordi jeg kan få en belønning hvis jeg gjør det bra

Veldig sant Litt sant Ikke veldig sant ikke sant

Del II

Bakgrunnsinformasjon

1. Klasse:

2. Kjønn: Gutt ☐ Jente ☐

3. Mors yrke:

4. Fars yrke:

5. Hva er den høyeste akademiske kvalifikasjoner gjennomført av moren din?

   Fullført barneskole / ungdomsskole ☐

   Fullført videregående yrkesrettet utdanning ☐

   Fullført videregående skole allmennfaglig linje (med studiekompetanse) ☐

   Høyerere yrkesopplæring ☐

   Universitetsgrad (bachelor, master, PhD) ☐

   Navn på grad eller teknisk program gjennomført av moren din:

6. Hva er den høyeste akademiske kvalifikasjoner gjennomført av din far?

   Fullført barneskole / ungdomsskole ☐

   Fullført videregående yrkesrettet utdanning ☐

   Fullført videregående skole allmennfaglig linje (med studiekompetanse) ☐

   Høyerere yrkesopplæring ☐

   Universitets grad (bachelor, master, PhD) ☐

   Navn på grad eller teknisk program gjennomført av faren din:

7. Vil du jobbe med naturfagsrelatert karriere i framtiden?

   Ja ☐

   Nei ☐

   Jeg har ingen mening ☐

   Har du en spesiell karriere som du ønsker å velge i fremtiden? Hvis ja fortelle hva det er.

8. Ønsker du å velge naturfag i videregående skole?

   Ja ☐

   Nei ☐

   Jeg har ikke bestemt seg ennå ☐

9. Hvordan vil du vurdere din ytelse generelt i naturfag?

   Meget god utøver ☐

   god utøver ☐

   gjennomsnittlig utøver ☐

10. Har du noen søstre / brødre som har studert naturfag ved videregående skole?
    Ja ☐ Nei ☐

11. Med hvilken av de følgende er du enig?

    Naturfag er lett for gutter og vanskelig for jenter ☐

    Naturfag er lett for jenter og vanskelig for gutter ☐

    Kompetanse i naturfag er ikke avhengig av kjønn ☐

Tusen takk for samarbeidet i besvarelsen av spørreskjemaet!

Appendix I: Questionnaires

C: Questionnaire (Sinhala translation)

ශිෂ්‍ය ප්‍රශ්නාවලිය

I කොටස : මා විද්‍යාව විෂය හදාරන්නේ ඇයි?

පහත ප්‍රශ්න 4 ට අදාළව දී ඇති එක් එක් ප්‍රකාශ වලින් ඔබ වඩාත් සුදුසුයැයි සිතන ප්‍රකාශයට යටින් ඉරක් අඳින්න.

(A) මා විද්‍යාව ගෙදර වැඩ කරන්නේ ඇයි?

1. මගේ ගුරුවරයාට මා හොඳ ශිෂ්‍යයෙකු බව පෙන්වීමට

   ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

2. එසේ නොකළහොත් මා ගුරුවරයාගේ කෝපයට ලක්විය හැකි බැවිනි

   ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

3. එය ඉතා විනෝදජනක බැවිනි

   ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

4. එසේ නොකළහොත් මට මා පිළිබඳ අප්‍රසාදයක් ඇති වන බැවිනි

   ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

5. මට විද්‍යා විෂය තේරුම් ගැනීමට අවශ්‍ය බැවිනි

   ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

6. මන්දයත් මා කළ යුතුව ඇත්තේ එය බැවිනි

   ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

7. මට විද්‍යාව ගෙදර වැඩ කිරීමෙන් සතුටක් ලැබෙන බැවිනි

   ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

8. විද්‍යාව ගෙදර වැඩ කිරීම මට වැදගත් වන බැවිනි

   ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

(B) මා පාසලේ පන්තිකාමරයේ දී විද්‍යාව ඉගෙනුම් කාර්යයන් කරන්නේ ඇයි?

9. එවිට ගුරුවරයා මට සිත රිදෙන සේ කථා නොකරන බැවිනි
   ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

10. මගේ ගුරුවරයා මා හොඳ ශිෂ්‍යයකු බව සිතීම මට අවශ්‍ය බැවිනි
    ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

11. මට නව දේවල් ඉගෙනීමට අවශ්‍ය බැවිනි
    ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

12. එසේ නොකළහොත් මට මා පිළිබඳ ලැජ්ජාවක් ඇති වන බැවිනි
    ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

13. එය විනෝදජනක බැවිනි
    ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

14. එය නීතිය බැවිනි
    ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

15. මට විද්‍යාව පාසැල් වැඩ කිරීම සතුටක් බැවිනි
    ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

16. පාසැල් විද්‍යාව ඉගෙනුම් කාර්යයන් කිරීම මට වැදගත් බැවිනි
    ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

(C) මා විද්‍යාව පන්ති කාමරයේදී අසීරු ප්‍රශ්නවලට පිළිතුරු දීමට උත්සාහ කරන්නේ ඇයි?

17. අනෙක් ශිෂ්‍යයන්ට මා දක්ෂයකු බව පෙන්වීමට අවශ්‍ය බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

18. මා ඊට උත්සාහ නොකළහොත් මට මා පිළිබඳ ලැජ්ජාවක් ඇතිවන බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

19. අසීරු ප්‍රශ්නවලට පිළිතුරු දීම මා හට සතුටක් ගෙන දෙන බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

20. මා කළ යුත්තේ එය බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

21. මා වැරදි ද නිවැරදිද යන්න දැන ගැනීම සඳහා

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

22. අසීරු ප්‍රශ්න වලට පිළිතුරු දීම විනෝදජනක බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

23. පන්තියේ දී අසීරු ප්‍රශ්නවලට පිළිතුරු දීම මා හට වැදගත් බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

24. මගේ ගුරුවරයා මා පිළිබඳ හොඳ දේ කියනු ලැබීම මට අවශ්‍ය බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

(D) මා සමස්තයක් ලෙස විද්‍යාව හොඳින් ඉගෙනීමට උත්සාහ කරන්නේ ඇයි?

25. මා කළ යුත්තේ එය බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

26. එවිට මගේ ගුරුවරු මා හොඳ ශිෂ්‍යයකු යැයි සිතන බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

27. මට විද්‍යාව හොඳින් ඉගෙනීමෙන් සතුටක් ලැබෙන බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

28. එසේ හොඳින් වැඩ කටයුතු නොකළහොත් මා හට ගැටලු ඇති වන බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

29. එසේ හොඳින් වැඩ කටයුතු නොකළහොත් මට මා පිළිබඳ අප්‍රසාදයක් ඇති වන බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

30. විද්‍යාව හොඳින් ඉගෙනීමට උත්සාහ කිරීම මා හට වැදගත් වන බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

31. මා එසේ හොඳින් කටයුතු කරන විට මට මා පිළිබඳ ආඩම්බරයක් ඇති වන බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

32. මා එසේ හොඳින් කටයුතු කළහොත් මට ප්‍රතිලාභයක් (දිරිගැන්වීමක්) ලැබෙන බැවිනි

ඉතා සත්‍යයි තරමක් දුරට සත්‍යයි එතරම් සත්‍ය නොවේ කිසිසේත්ම සත්‍ය නොවේ

II කොටස

1. පන්තිය :-

2. ගැහැණු ☐ පිරිමි ☐

3. මවගේ රැකියාව :-

4. පියාගේ රැකියාව:-

5. මවගේ ඉහළම අධ්‍යාපන සුදුසුකම කුමක්ද?

   අ.පො.ස (සා.පෙළ) ☐

   අ.පො.ස (උ.පෙළ) ☐

   විශ්ව විද්‍යාල උපාධිය ☐

   කාර්මික අධ්‍යාපනය (කාර්මික විද්‍යාලයකින්) ☐

   ඉහත කිසිවක් නැත ☐

   ඔබගේ මව උපාධිධාරිණියක් නම් ලබා ඇති ඉහළම උපාධියේ/ කාර්මික පාඨමාලාවේ නම:

6. පියාගේ ඉහළම අධ්‍යාපන සුදුසුකම කුමක්ද?

   අ.පො.ස (සා.පෙළ) ☐

   අ.පො.ස (උ.පෙළ) ☐

   විශ්ව විද්‍යාල උපාධිය ☐

   කාර්මික අධ්‍යාපනය (කාර්මික විද්‍යාලයකින්) ☐

   ඉහත කිසිවක් නැත ☐

   ඔබගේ පියා උපාධිධාරියෙකු නම් ලබා ඇති ඉහළම උපාධියේ/ කාර්මික පාඨමාලාවේ නම:

7. අනාගතයේදී විද්‍යාව හා සෘජුව සම්බන්ධ රැකියාවක නිරතවීමට ඔබ කැමැත්තක් දක්වන්නේ ද?

   ඔව් ☐

   නැත ☐

   කිව නොහැක ☐

   අනාගතයේ කිරීමට අපේක්ෂා කරන රැකියාවක් තිබේද? එසේ නම් එය කුමක්ද?

8. අ.පොෂ. (උ.පෙළ) විභාගය සඳහා විද්‍යාව (ජෛවීය විද්‍යාව හෝ භෞතීය විද්‍යා) තෝරා ගැනීමට ඔබ බලාපොරොත්තු වන්නේ ද?

ඔව් ☐

නැත ☐

තවම තීරණය කර නොමැත ☐

9. ඔබට උසස් පෙළ සඳහා විද්‍යා විෂයන් හැදෑරූ සහෝදර සහෝදරියන් සිටීද?

ඔව් ☐

නැත ☐

10. ඔබගේ හැඟීම පරිදි ඔබ විද්‍යාව විෂයට,

ඉතා දක්ෂයි ☐

දක්ෂයි ☐

සාමාන්‍යයි ☐

11. ඔබ ගැහැණු/පිරිමි ළමයෙකු නිසා විද්‍යා විෂය අසීරු/පහසු වන්නේ දැයි ඔබ සිතන්නේද?

ඔව් ☐ නැත ☐

මෙම ප්‍රශ්නාවලිය සම්පූර්ණ කිරීමෙන් ඔබ දැක් වූ සහයෝගයට ස්තූතියි!!

Appendix II: Interview guides

A: Interview guide for students

1) Do you enjoy learning science?

2) Why do you/ don't you like to learn science?

3) Do you have any family members who have a science education background?

4) How do your parents encourage you to learn science?

5) Do you get enough support from your science teacher to learn science?

6) Do you get any extra help for your science lessons from anyone other than your science teacher?

7) Do you think you get enough chances to interact with other students in the science lessons?

8) How do you think about your performance in science?

9) Have you decided that you will select science in upper secondary school?

10) Do you have a future ambition? Do you like to do a science related career in future? Why? Do your parents want you to engage in a science related job?

11) Do you think you get the chance to do what you like in the science lessons?

12) If you have the chance to change the way science is taught in school, how do you like to change it?

13) Do you believe science is easy/ hard because you are a girl/ boy?

B: Interview guide for teachers

1) What factors have you identified as motivating and demotivating students to learn science?

2) What strategies do you employ to motivate learners to learn science?

3) What hinders the students from gaining the competencies that are expected to be achieved?

4) When do the students enjoy your science lesson the most?

5) Do you create opportunities for student-initiated activities?

6) Are you happy/ satisfied as a science teacher?

7) Do you believe you have the necessary skills and competences to be a successful science teacher?

8) What is your idea about the most suitable method of teaching science to secondary students?

9) What is your view about girls' and boys' performance in science?

Appendix III: Consent forms

A: Consent form for participation (English)

University of Oslo

1) Name of the research: Motivation to learn science among secondary students: A comparative study between Sri Lanka and Norway

2) Name of the researcher and affiliated institute: Nisanka Rajapakse Mohottige, University of Oslo

3) Name of the supervisor: Tove Kvil

4) Description of the research: The rationale of the study is to determine the type of motivation of secondary level students to learn science from a Self determination theory perspective. The study is a comparative study between Norway and Sri Lanka. The study consists of quantitative and qualitative dimensions. Quantitative data will be collected by administering a questionnaire to 10^{th} Grade students and it will consume maximum 20 minutes to complete. Moreover, interviews will be conducted with students and teachers in order to collect qualitative data. Each interview will probably consume 30 minutes. The Norwegian Social Science Data Service (NSD) has granted approval for this research.

5) Benefits: The findings of this research can be a source for further research and for stake holders in both countries.

6) Confidentiality: No directly person identifiable data (eg. name) will be collected in this study and all indirectly person identifiable data (eg. school, class, gender) will be anonymized at the end of the study. Until the end of the study all data will be stored in devices which are only accessible by the principal researcher.

7) Participation: Your participation in this research is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study.

8) Further questions: If you have any further questions regarding this study or if you want to know the findings of this research you can contact the researcher by nurajapa@student.uv.uio.no

I ……..(name) have read and understood the above information about this research and I freely agree to participate in the study.

…….. ……

Signature of the participant Date

B: Consent form for participation (Norwegian)

Samtykkeerklæring for deltakelse i en Masters Forskning studie

Universitetet i Oslo

1) Navnet på forskning : Motivasjon for å lære realfag blant ungdomskole elever: En sammenlignende studie mellom Sri Lanka og Norge

2) Navn på forsker og tilknyttet instituttet : Nisanka Rajapakse Mohottige, Universitetet i Oslo

3) Navn på veileder : Tove Kvil

4) Beskrivelse av forskningen : Begrunnelsen med studien er å finne ut hvilken type motivasjon for videregående nivå studenter til å lære naturfag fra en Selvbestemmelse theori perspektiv. Studien er en komparativ studie mellom Norge og Sri Lanka . Studien består av kvantitative og kvalitative mål. Kvantitative data vil bli samlet inn ved å administrere et spørreskjema til 10. klasse elever og det vil forbruke maksimum 20 minutter å fullføre . Videre vil intervjuer bli gjennomført med elever og lærere for å samle inn kvalitative data. Hvert intervju vil trolig konsumere 30 minutter. Norsk samfunnsvitenskapelig datatjeneste (NSD) har gitt godkjenning for denne forskningen.

5) Fordeler : Resultatene av denne forskningen kan være en kilde for videre forskning og for interessenter i begge land.

6) Konfidensialitet : Ingen direkte person identifiserbare data (eg. navn) vil bli samlet i denne studien, og alle indirekte person identifiserbare data (f.eks skole , klasse, kjønn) vil bli anonymisert ved slutten av studien. Frem til slutten av studien alle data vil bli lagret i enheter som bare er tilgjengelig med rektor forsker.

7) Deltakelse: Din deltakelse i denne forskningen er frivillig . Du kan velge ikke å delta og du kan trekke tilbake ditt samtykke til å delta når som helst. Du vil ikke bli straffet på noen måte bør du bestemmer deg for ikke å delta eller å trekke seg fra denne studien.

8) Flere spørsmål : Hvis du har ytterligere spørsmål angående denne studien , eller hvis du ønsker å vite resultatene av denne forskningen kan du kontakte forsker ved nurajapa@student.uv.uio.no

Jeg ..... (navn) har lest og forstått ovenstående informasjon om denne forskningen, og jeg fritt enige om å delta i studien.

....

Underskrift av deltakeren Dato

පශ්චාත් උපාධි පර්යේෂණයකට ස්වේච්ඡාවෙන් සහභාගී වීම සඳහා කැමැත්ත පළ කිරීම

1. **පර්යේෂණයේ නම :-**

   විද්‍යාව විෂය ඉගෙනීම සඳහා ශ්‍රී ලාංකික ද්විතියික පාසල් ශිෂ්‍යයන්ගේ අභිප්‍රේරණය.

2. **පර්යේෂකයාගේ නම හා අනුබද්ධ ආයතනය :-**

   නිසංකා උත්පලානි සෝමරත්න

   අධ්‍යාපනික විද්‍යා පීඨය, අධ්‍යාපන පර්යේෂණ දෙපාර්තමේන්තුව, ඔස්ලෝ විශ්වවිද්‍යාලය, නෝර්වේ

3. **පර්යේෂණය පිළිබඳ හැඳින්වීම :-**

   මෙම පර්යේෂණය විද්‍යාව විෂය ඉගෙනීම සඳහා ශ්‍රී ලාංකීය ද්විතියික පාසල් ශිෂ්‍යයන් තුළ ඇති අභිප්‍රේරණය පිළිබඳ වන අතර ප්‍රමාණාත්මක හා ගුණාත්මක මානයන් දෙක යටතේ සැලසුම් කර ඇත. ගුණාත්මක මානය යටතේ සිසුන් හා විද්‍යා ගුරුභවතුන් සමඟ සම්මුඛ සාකච්ඡා පැවැත්වෙන අතර ප්‍රමාණාත්මක මානය යටතේ සිසුන් සඳහා ප්‍රශ්නාවලියක් භාවිත වේ. සම්මුඛ සාකච්ඡාවකට විනාඩි 30 ක් පමණ ගත වන අතර ප්‍රශ්නාවලිය සම්පූර්ණ කිරීමට විනාඩි 15 ක් පමණ ගත වනු ඇත.

   මෙම පර්යේෂණය සඳහා නෝර්වීජියානු සමාජීය විද්‍යා දත්ත සේවයේ (Norwegian Social Science Data Service) අනුමැතිය ලැබී ඇත.

4. **ප්‍රතිලාභ :-**

   මෙම පර්යේෂණයේ ප්‍රතිඵල අධ්‍යාපනයේ විවිධ පාර්ශවකරුවන්ට විශේෂයෙන් ප්‍රතිපත්ති සම්පාදකයින්ට අතිශයින් ප්‍රයෝජනවත් විය හැක.

5. **තොරතුරුවල රහස්‍යභාවය :-**

   මෙම පර්යේෂණය සඳහා සෘජුව ඔබ හඳුනාගැනීමේ තොරතුරු (උදා :- නම) කිසිවක් එක්රැස් නොකෙරෙන අතර වක්‍රව ඔබ හඳුනාගැනීමේ තොරතුරු (උදා :- පාසල, පන්තිය) පර්යේෂණයෙන් අනතුරුව පුද්ගලයා හඳුනාගත නොහැකි තත්ත්වයට පත් කෙරෙනු ඇත.

6. **පර්යේෂණයට සහභාගි වීම :-**

   මෙම පර්යේෂණයට සහභාගිවීම ස්වේච්ඡාවෙන් වන අතර යම් හේතුවක් මත ඔබට අවශ්‍ය නම් ඕනෑම මොහොතක මින් ඉවත්වීමේ අයිතිය ඔබ සතුව ඇත. ඔබ මෙම පර්යේෂණයෙන් ඉවත් වුවද ඔබට ඉන් කිසිම අගතියක් සිදුනොවේ.

මම ඉහත සඳහන් කරුණු හොඳින් කියවා තේරුම් ගත් අතර මෙම පර්යේෂණයට (ප්‍රශ්නාවලිය පිරවීමට/සම්මුඛ සාකච්ඡාවට) සහභාගි වීමට කැමැත්ත පළ කර සිටිමි.

....

දිනය සහභාගිවන්නාගේ අත්සන

නිසංකා උත්පලානි සෝමරත්න
364, ශාන්ති මාවත,
මාකුඹුර,
පන්නිපිටිය.
03.10.2013

කලාප අධ්‍යාපන අධ්‍යක්ෂ,
ශ්‍රී ජයවර්ධනපුර කලාප අධ්‍යාපන කාර්යාලය,
බත්තරමුල්ල.

පශ්චාත් උපාධි පර්යේෂණයකට පාසල් ළමුන්ට ප්‍රශ්නාවලියක් ලබාදීමට අවසර ලබා ගැනීම.

මහත්මයාණනි,

ඉහත නම් සඳහන් මම නෝර්වේහි ඔස්ලෝ විශ්ව විද්‍යාලයේ තුලනාත්මක හා ජාත්‍යන්තර අධ්‍යාපනය පිළිබඳ පශ්චාත් උපාධි අපේක්ෂිකාවක වන අතර මාගේ පර්යේෂණයක් සඳහා 8, 9, 10 ශ්‍රේණි වල සිසුන් සඳහා ප්‍රශ්නාවලියක් ලබාදීමට අවශ්‍යව ඇත. මෙය විද්‍යාව ඉගෙනීමට ඇති අභිප්‍රේරණය පිළිබඳව වන අතර මිනිත්තු 15 ක් පමණ ගතවන කෙටි ප්‍රශ්නාවලියකි. මේ සඳහා ඔබ කලාපයේ පාසැල් 2 ක් යොදා ගැනීමට ඉතා කාරුණ්‍යාවෙන් අවසර ඉල්ලා සිටිමි.

ස්තුතියි.

මෙයට,
විශ්වාසී,
N. Somaratna

විදුහල්පති
කොට්ටාව ධර්මපාල විදුහල
අධ්‍යාපන පර්යේෂණ කටයුත්තක්
[illegible] 15 ක්
කාලයක් [illegible] කටයුත්තට
අවසර ලබා දීම නිර්දේශ කරමි

2013.10.3

Kumarage Karunarathne
Assistant Director of Education
(School Administration)
Zonal Education Office
Sri Jayawardenapura.

නිසංකා උත්පලානි සෝමරත්න,
364, ශාන්ති මාවත,
මාකුඹුර,
පන්නිපිටිය.
03.10.2013

ජාතික පාසල් අධ්‍යක්ෂ,
අධ්‍යාපන අමාත්‍යාංශය,
ඉසුරුපාය,
බත්තරමුල්ල.

පශ්චාත් උපාධි පර්යේෂණයකට පාසලක් යොදා ගැනීමට අවසර ලබා ගැනීම.

මහත්මයාණනි,

ඉහත නම් සඳහන් මා නෝර්වේහි ඔස්ලෝ විශ්ව විද්‍යාලයේ තුලනාත්මක හා ජාත්‍යන්තර අධ්‍යාපනය පිළිබඳ පශ්චාත් උපාධි අපේක්ෂිකාවක වන අතර මාගේ පර්යේෂණයක් සඳහා පන්නිපිටිය ධර්මපාල විද්‍යාලය යොදා ගැනීමට අවශ්‍යව ඇත. මෙම පර්යේෂණය විද්‍යාව විෂය ඉගෙනීමට සිසුන් තුළ ඇති අභිප්‍රේරණය පිළිබඳ වන අතර ප්‍රමාණාත්මක හා ගුණාත්මක අංශ දෙක යටතේ සැලසුම් කර ඇත.

ප්‍රමාණාත්මක කොටස - ~~8, 9~~, 10, 11 ශ්‍රේණි වල සිසුන් සඳහා කෙටි (මිනි.15) ප්‍රශ්නාවලියක් ලබා දීම 10/11 පමණ දෙන්න.

ගුණාත්මක කොටස - සිසුන් 6 සමඟ කෙටි සම්මුඛ සාකච්ඡා~~වක්~~ පැවැත්වීම.
විද්‍යාව විෂය උගන්වන ගුරුවරුන් 2ක සමඟ කෙටි සම්මුඛ සාකච්ඡා පැවැත්වීම.

මෙම පර්යේෂණය පැවැත්වීමට ඉහත නම් සඳහන් පාසල යොදා ගැනීමට අවසර දෙන මෙන් ඉතා කරුණාවෙන් ඉල්ලා සිටිමි.

ස්තූතියි.

මෙයට,
විශ්වාසී,
N. Somaratne

පී. ඒ. එස්. පී. ජයලත්
සහකාර අධ්‍යාපන අධ්‍යක්ෂ
ජාතික පාසල් ශාඛාව
අධ්‍යාපන අමාත්‍යාංශය
"ඉසුරුපාය"
බත්තරමුල්ල.

UiO : Department of Education
University of Oslo

To whom it may concern

Date: 17.09.2013
Your ref.:
Our ref.: Camilla.bakke@iped.uio.no

Letter of Support for conducting field work

I hereby confirm that Nisanka Uthpalani Somaratne Rajapakse Mohottige, born 16.02.1982, is a full time student in the Master of Philosophy in Comparative and International Education master programme at the Department of Education at the University of Oslo.

In the second year our students are required to write a Master Thesis of 80 to 120 pages. This thesis should preferably be based on field studies conducted in countries outside of Norway. The fieldwork may incorporate interviews with educational practitioners and decision-makers, classroom observation and documentary analysis. The type of data gathered should of course be discussed with the relevant authorities. It is our hope that the work produced by this student will not only benefit him in his academic career but also be of use in the future

Nisanka Uthpalani Somaratne Rajapakse Mohottige is planning to do her fieldwork in Sri Lanka and Norway during the period of September 17th until November 17th 2013.

We kindly ask you to give her all possible assistance during her fieldwork in Sri Lanka and Norway

Best regards,

Camilla Bakke
Senior Executive Officer
Department of Education

UNIVERSITY OF OSLO
Department of Education
P.O.Box 1092 Blindern
N-0317 Oslo

Department of Education
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Visiting addr.: Sem Sælands vei 7 Helga Engs hus, 5. etasje

Phone: (+47) 22 84 44 75
Telefax: (+47) 22 85 42 50
postmottak@uv.uio.no
www.uv.uio.no
Org. no.: 971 035 854

[illegible]

නිසංකා උත්පලානි සෝමරත්න,
364, ශාන්ති මාවත,
මාකුඹුර,
පන්නිපිටිය.
09.10.2013

කලාප අධ්‍යාපන අධ්‍යක්ෂතුමා,
අධ්‍යාපන කලාපය හෝමාගම
හෝමාගම.

<u>පශ්චාත් උපාධි පර්යේෂණයකට පාසලක් යොදා ගැනීමට අවසර ලබා ගැනීම.</u>

මහත්මයාණනි,

ඉහත නම් සඳහන් මා නෝර්වේ හි ඔස්ලෝ විශ්ව විද්‍යාලයේ තුලනාත්මක හා ජාත්‍යන්තර අධ්‍යාපනය පිළිබඳ පශ්චාත් උපාධි අපේක්ෂිකාවක වන අතර මාගේ පර්යේෂණයක් සඳහා පාසල් 2 ක් ලබා ගැනීමට අවශ්‍යව ඇත. මෙම පර්යේෂණය විද්‍යාව විෂය ඉගෙනීමට සිසුන් තුළ ඇති අභිප්‍රේරණය පිළිබඳ වන අතර ප්‍රමාණාත්මක හා ගුණාත්මක අංශ දෙක යටතේ සැලසුම් කර ඇත.

ප්‍රමාණාත්මක කොටස - 10, 11 ශ්‍රේණිවල සිසුන් සඳහා කෙටි (මිනි. 15 පමණ) ප්‍රශ්නාවලියක් ලබා දීම.

ගුණාත්මක කොටස - සිසුන් 6 සමඟ ~~කෙටි~~ සහ විද්‍යාව විෂය උගන්වන ගුරුභවතුන් 2 ක සමඟ කෙටි සම්මුඛ සාකච්ඡා පැවැත්වීම.

මෙම පර්යේෂණය පැවැත්වීමට පාසල් 2 ක් ලබා දෙන මෙන් ඉතා කාරුණ්‍යාවෙන් ඉල්ලා සිටිමි.

ස්තූතියි.

මෙයට,
විශ්වාසී,
N Somaratne

පිටපත්
1. හෝමාගම ම.ම.වි.
2. කිරිවත්තුඩුව විජයවර්ධන ම.වි.

නි.පු. මෙම අධ්‍යයන කටයුත්ත සඳහා අවශ්‍ය සහයෝගය ලබා දෙන්න.
2013/10/09

ආර්. ජී. ජේ. රණසිංහ
සහකාර අධ්‍යාපන අධ්‍යක්ෂ [illegible]
කලාප අධ්‍යාපන කාර්යාලය
හෝමාගම.