Perceived self-efficacy as a factor realising choice satisfaction regarding post-compulsory Physical Sciences.

by

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Declaration

I hereby declare that this Dissertation is a product of my own drudgery, despair, panic and procrastination. I kept calm, revisited and resubmitted this work to my supervisors, and now submit this as my own and original, not previously been submitted for degree purposes at any other institution of higher learning, in fulfilment of the requirements for the degree Magister Educationis at the University of the Free State.

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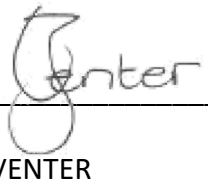

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DATE

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I acknowledge, as part of my opportunity set, some of the valuable human beings without whom, by Grace alone, my life trajectory would not have been the same. These people include all of those who had to cope with me finding my feet in the academic world (see 6.5) as well as my core family:

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Dedication

Thank you for providing me the opportunities I value, making it possible for me to transform my life towards an awareness of a life of quality for all:

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Abstract

Societies are dependent on learners studying Science, Technology, Engineering and Mathematics in order to address, for example, issues related to health, sustainability and poverty. There is a global decline in the uptake of STEM-related studies by learners at post-compulsory level, which has prompted a worldwide research focus on factors that can influence renewed learner interest in the uptake of studies related to this field. Researchers have identified four groups of factors which influence post-compulsory uptake of Science: Systemic, School, External and Individual. Self-efficacy, a concept from Social Cognitive Theory, forms part of the group of individual factors, and is under-researched in science education on post-compulsory level. Self-efficacy can also be incorporated into the Capability Approach as a conversion factor. Conversion factors transform available opportunities into realised opportunities. In this study I argue that perceived self-efficacy can possibly be seen as 'perceived power', in other words a personal conversion factor towards post-compulsory choice satisfaction in the context of Physical Sciences. Given the firmly established role of perceived self-efficacy in affecting a variety of aspects of people's lives, it is conceivable for the level of perceived self-efficacy employed to affect the extent to which learners realise post-compulsory choice satisfaction regarding Physical Sciences. In 2017, I surveyed 541 Grade 10 learners from the Lejweleputswa district in the Free State, South-Africa. These Grade 10 learners were surveyed, from a capabilities perspective, on their perceived self-efficacy, satisfaction with choice regarding Physical Sciences, and some basic opportunities identified in education. Biographical data were also collected with the aim of including an account regarding the structural constraints and human diversity of learners. From a capabilities perspective, structural constraints relate to policies and institutions influencing learner opportunities, while an account of human diversity includes elements like gender and ethnicity. A simple linear regression was done to determine the relationship between perceived self-efficacy and satisfaction with choice. Multiple regression was done to adjust for biographical factors and basic opportunities identified in education. The findings show a statistically significant positive relationship between perceived self-efficacy and choice satisfaction regarding Physical Sciences. A relationship independent of biographical factors and mediated by basic opportunities in education was found. Statistically the influence of perceived self-efficacy on choice satisfaction, although small, is independent of biographical

factors and basic realised opportunities in education. It is therefore conceivable that perceived self-efficacy can be seen as a personal conversion factor. This could have numerous implications regarding further research, teaching practise and policy-making.

Key words:

Achieved opportunities

Agency

Capabilities Approach

Conversion factors

Perceived power

Perceived self-efficacy

Realised opportunities

List of abbreviations

BROE	-	Basic realised opportunities in education
CA	-	Capabilities Approach
DBE	-	Department of Basic Education
FET	-	Further Education and Training
FSDoE	-	Free State Department of Education
FraIM	-	The Framework for Integrated Methodologies
IKS	-	Indigenous Knowledge Systems
NCS	-	National Curriculum Statement
PS	-	Physical Sciences
PSE	-	Perceived self-efficacy
SA	-	South Africa
SCT	-	Social Cognitive Theory
STEM	-	Science, Technology, Engineering and Mathematics
TRD	-	Triadic Reciprocal Determinism

List of definitions

Capabilities Approach:	a people-centred research approach concerned with individual well-being of people of a country, and as such focusses on opportunities available to each person.
Entry points:	opportunities presented to students to take up a field of study that has some prerequisites, or selection requirements.
External factors:	factors external to a school, which contribute to learners' opportunity to learn as well as their educational well-being, such as factors on family or community level.
Individual factors:	factors on individual level that contribute to learners' opportunity to learn, and their educational well-being.
School factors:	factors regulated by schools on organisational level that contribute to learners' opportunity to learn and educational well-being.
Systemic factors:	factors related to laws of a country and the specific educational system that governs schools to provide learners with an opportunity to better their educational well-being.
Perceived self-efficacy:	the personal belief in one's competence to cope with future situations; in this context, the individual's belief in their own ability to respond to novel situations, as well as their ability to deal with any associated setbacks.
Post-compulsory level:	includes any level of study where a learner or student has the power to consciously make a decision regarding chosen learning area(s) to engage in. In South Africa this is from Grade 10.
Physical Sciences:	physical science is a branch of natural science were non-living systems are studied. It in turn has many branches, nonetheless in South Africa, Physics and Chemistry are combined into one learning area, 'Physical Sciences'.
Grade 10 learner:	in South Africa, a learner on post-compulsory level, in the first of three years of the Further Education and Training (FET) phase. After completion of the FET phase a learner obtains a National Senior Certificate, and based on the results thereof, may progress to Higher Education

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CHAPTER 1: OUTLINE OF THE PROJECT

1.1 INTRODUCTION

In this study I focus on Grade 10 learners' post-compulsory choice regarding Physical Sciences (PS). Since Grade 10 in South Africa (SA) is a critical decision point (Department of Basic Education, 2013), it is important to understand choice at this level (Bennett, Braund & Sharpe, 2013). In fact, the observation is that not many learners who choose PS continue with Science, Technology, Engineering and Mathematics (STEM) studies at tertiary level (Spence & Albion, 2013). Also, those who do choose PS often display a high dropout rate (Department of Basic Education, 2010; Department of Basic Education South Africa, 2011).

At the age of approximately fifteen, in Further Education and Training (FET) in South Africa (SA), learners are required to make more focused choices regarding subjects (Department of Basic Education, 2013). Consequently PS, a combination of Chemistry and Physics, is introduced as one of the learning areas in the National Curriculum Statement (NCS) from Grade 10 to Grade 12 (Department of Basic Education, 2013). A decline in the uptake of PS has been experienced over the last few years in SA, and government is implementing strategies with the aim of overcoming this problem (Department of Basic Education South Africa, 2011). This decline in uptake of Science subjects is not only a problem in SA (Department of Basic Education, 2016), but is also an international trend (Taylor, 2014). Researchers like Bennett, Braund and Sharpe (2013) found that four groups of factors influences the uptake of STEM subjects: Systemic, School, External and Individual. One of the individual factors stated is perceived self-efficacy (PSE) from Social Cognitive Theory (SCT) (Bennett, et al., 2013). PSE is known to affect the choices people make (Bandura, 1994).

It is important to understand the concept of choice, since the choices people make influence their life trajectories (Bandura, Barbaranelli, Caprara & Pastorelli, 2001). In the context of this study, I expect that the choice of post-compulsory uptake regarding PS might be influenced by the level of Grade 10 learners' PSE. PSE, from the perspective of SCT, is seen as the accuracy of self-judgements which influences performance (Bandura, 2012). From the perspective of another research approach, namely the Capability Approach (CA), I suggest that PSE could

probably be conceptualised as a conversion factor, or a personal resource, used by people to activate their available opportunities into realised opportunities (Robeyns, 2017). By employing the CA, as a people-centred approach in order to conceptualise PSE as conversion factor, it might be possible to form a better understanding about the post-compulsory choice of Grade 10 learners in the context of PS.

At present there is no holistic framework in South Africa towards understanding Grade 10 learners' post-compulsory choice in the context of PS. In this study I describe the theoretical relationships between PSE, from SCT, and learners' post-compulsory choice, from a CA perspective. The CA is employed to investigate Grade 10 learners' real opportunities and whether certain opportunities in education, as operationalised in Ruswa's questionnaire (2015), have been realised by the learners. In creating this questionnaire towards the numerical measurement of opportunities, Ruswa drew on the work of, among others, Amartya Sen, Elaine Unterhalter and Melanie Walker (Unterhalter & Brighouse, 2007; Unterhalter & Walker, 2007). I claim that Ruswa's questionnaire (see 4.6.2) assess basic realised opportunities in education (BROE) and use BROE to assess the basic realised opportunities in education of Grade 10 learners forming part of this sample.

1.2 RATIONALE

Having been a PS teacher for over 20 years I also followed my interest in learner wellbeing by completing a BSC Hons in Psychology as well as a B Psych in Community Psychology. From the psychology perspective I observed the effect of post-compulsory subject choices in many learners' lives. Most learners come into the Grade 10 PS class with sparkling eyes and wild dreams. To me, however, it seems as if most of them have no personal goals and no idea about which personal values will affect the course of their lives. After a few weeks, however, many of these learners become disillusioned with the amount of work and the level of cognitive functioning expected of them. The result of this disillusionment is that these learners lose faith in themselves and drop out. The flipside of the coin is that some learners never choose PS since they see it as too big of a challenge, only to realise later on that they might have coped, and that possible future career choices are now closed to them because of this choice.

Over the years I have also observed cases where learners from dire circumstances, with all the odds against them, and appearing to have no hope of making a success regarding their study of PS, have succeeded well beyond expectation. I have also seen learners who appear to have every opportunity to make a great success of their studies regarding PS, but who then fail miserably.

I continually observe that post-compulsory subject choices affect the quality of learners' lives. This might be their quality of life during their school career due to not being able to cope with daily stresses such as some challenges involved in taking PS. It might also be their quality of life after school, when as adults they have to settle for a career which is not their passion as a result of having made an inappropriate subject choice. In the light of a global shortage of learners taking up STEM related subjects, as well as my own passionate feelings regarding this matter, I considered it valuable to undertake this study.

1.3 OVERVIEW OF THE PROBLEM

The current report on human development, as part of the United Nations Development Programme, gives a statistical account on human development, inclusive of environmental sustainability with changes in energy consumption, unsafe water, sanitation and hygiene services, towards reaching development goals (Human Development Report Office, 2018). To meet such imperatives requires learners to study STEM-related subjects at post-compulsory level. However, there is a global shortage of students in this field (The New York Academy of Sciences, 2014). This shortage has incentivised an international and national focus on STEM education (Department of Basic Education South Africa, 2011).

1.3.1 DECLINE IN POST-COMPULSORY UPTAKE OF SCIENCE SUBJECTS

In South Africa, including the Free State province where I am situated, has been decline in PS learner enrolment from 2014 – 2017 (EMIS, 2017) (see Table 2-1). This drop in uptake of Science subjects also presents itself as an international trend, for example with Spence and Albion (2013) recognising the problem in Australia. A decline in uptake of A-level Physics and Chemistry in England was reported by Bennett, Hampden-Thompson and Lubben (2011).

1.3.2 GROUPS OF FACTORS INFLUENCING THIS DECLINE

Four groups of factors influencing post-compulsory uptake of STEM subjects have been identified by Bennett, et al. (2013). These groups of factors are: Systemic; School; External; Individual. Each of these groups of factors can be broken down into multiple factors, having different implications on national and international levels.

Systemically, funding and the amount of entry points into a STEM-related field of study both play a role regarding uptake (Bennett, et al., 2013). Firstly, regarding funding. The South African government established the quintile system towards allocating funds to schools by dividing schools into five quintiles (Department of Education, 2003). Schools serving poorer communities receive proportionally more funding from government than those serving more affluent people. Secondly, regarding the amount of entry points into a STEM-related field of study. The National Curriculum Statement in SA (NCS) (Department of Basic Education, 2013) makes provision for learners to be formally educated in STEM-related fields from as early as Grade 4 (10 years of age).

Identified school factors include the school's demographic factors, time table, and competence and capacity of the principal. Researchers like Spaull (2012) have shown how geographical inaccessibility of schools in SA has a negative impact on performance. Factors other than school factors that may play a role towards uptake of PS are external factors. Such factors can be, for example the development of skills such as argumentation to promote learners cognitive development (Ogunniyi & Hewson, 2008). Another example of an external factor can be Indigenous Knowledge Systems (IKS) (Taylor & Cameron, 2016). By employing IKS learners are empowered to master the knowledge required for successful completion of an amount of work with more ease.

Bennet, et al. (2013) have realised that a group of factors which have been under-researched in the context of education, and specifically in the context of STEM education, fall in the category the individual factors. These factors include personal aspects such as *mindset* (Dweck, 2012) and grit (Duckworth, 2017) which, from a positive psychology point of view, can contribute to positive attitudes regarding STEM education. Positive attitudes can contribute greatly towards success (Duckworth, 2017). Positive attitudes can also influence

personal choices and the post-compulsory uptake of STEM-related studies (Bennett, et al., 2013).

1.4 RESEARCH AIM AND OBJECTIVES

My aim with this project is to research factors that might impact the decline of post-compulsory uptake of PS. One way of trying to explain this decline is to gain more information on specific factor(s) influencing learners' choice satisfaction. My expectation is that learners with a higher PSE would have judged their own abilities, in the context of post-compulsory PS, better, and would therefore have made subject choices that they are satisfied with and that they value.

PSE is a construct from SCT and is known to affect choice (Bandura, 1994). PSE has developed from SCT through positive psychology, as a powerful construct in the decision-making processes (Bandura, 2011). This study aims at focusing on PSE as an individual factor influencing learners' choice satisfaction in the context of post-compulsory PS.

A meta-analytic path-analysis done on the influences of efficacy, openness to experience, conscientiousness, extraversion, agreeableness and neuroticism on performance, found that students use their self-efficacy beliefs to aid their functioning (Stajkovic, Bandura, Locke, Lee & Sergent, 2018). Empirical knowledge also suggests that self-efficacy affects the choices people make. An example is that female students with higher perceived self-efficacy are more likely to consider a career in engineering than their fellow female students with lower perceived self-efficacy (Johnson & Muse, 2017). Bennett, et al. (2013) suggest that the theoretical and empirical links between self-efficacy and post-compulsory uptake of Science subjects are worth investigating.

My aim is to develop a conceptual framework (see Chapter 3) by integrating theory from SCT and the CA towards operationalising PSE as a personal conversion factor. This newly developed conceptual framework is employed as a narrow capability application to quantify the usefulness of PSE, operationalised as personal conversion factor, transforming post-compulsory subject choice into choice satisfaction in the context of Grade 10 PS.

1.5 PROPOSED THEORETICAL AND CONCEPTUAL FRAMEWORK

Extensive theoretical and empirical work suggest that PSE influences behaviour (Bandura, 1994), and that PSE is seen as a driving force towards motivating agency or intent. Through agency, people can successfully employ another process central to SCT, namely Triadic Reciprocal Determinism (TRD) (Bandura, 2006). By employing TRD (see 3.2.1.1), people can direct their thoughts, better their experiences and enhance their performance (Bandura, 2006). Through agency, PSE can therefore enhance a person's performance.

Researchers like Ingrid Robeyns (2017) make use of Amartya Sen's Capability Approach in theorising that a person can transform available opportunities into achievement by making use of some accessible conversion factors. In this study I propose PSE to be a personal conversion factor, and that the level of PSE mastered by a learner can contribute to the learner transforming an available opportunity of post-compulsory subject choice into achieving post-compulsory choice satisfaction, in the context of PS.

1.6 RESEARCH METHODOLOGY

David Plowright (2011) suggests an integrated pragmatic methodology, the *framework for integrated methodologies* or *FraIM*. According to Plowright (2011), researchers can solve problems pragmatically with the aim of answering research questions. Methods should not restrict researchers to work numerically (quantitatively) or narratively (qualitatively), as long as research questions can be answered in a warrantable, thus reliable and valid, manner. By following *FraIM*, processes are carried out during different stages of the research process, where researchers are allowed to make choices appropriate to answering specific research questions (Plowright, 2011). The stages to complete during the course of this project are: Asking research questions; Sampling; Data collection; Data analysis; Providing evidence; Explanation of claims; and the Drawing of warrantable conclusions.

The research question asked in this project emerged from the literature review (Chapter 2) and the conceptual framework (developed in Chapter 3). The research question to be answered is: To what extent can perceived self-efficacy be seen as a personal conversion factor towards post-compulsory choice satisfaction regarding Physical Sciences? In this regard, the following sub questions need to be answered:

- How is perceived self-efficacy related to Grade 10 learners' choice satisfaction regarding post-compulsory uptake of Physical Sciences?

- How is perceived self-efficacy related to post-compulsory choice satisfaction of Grade 10 learners, regarding Physical Sciences, when taking into account some biographical factors and basic realised opportunities in education?

To answer these research questions, as will be discussed in the sections to follow, Grade 10 learners were sampled purposively as well as conveniently to answer surveys consisting of questionnaires about the three variables of interest: choice satisfaction, PSE and BROE. Data were collected from participating schools between August and September 2017, and the analysis phase commenced in October 2017.

1.6.1 SAMPLING AND ETHICS

Learners were sampled from the Lejweleputswa District in the Free State where seven schools with diverse characteristics agreed to participate in the project. Schools which gave all learners the option of taking PS as a subject at post-compulsory level were purposively included in the sample.

Ethical clearance was obtained from the Ethical committee of the Department of Education at the University of the Free State (UFS-HSD2017/0134). The letter in this regard is attached as Appendix D. The Department of Education in the Free State gave permission for the research project to be carried out (see Appendix A), the individual school principals agreed on behalf of their schools to participate (see Appendix B), and parental consent and learner assent were obtained for each learner who completed a survey (see Appendix C). I undertook to treat all data and identities as confidential during the gathering, reporting and storage thereof. I further undertook not to disrupt normal learning, that all processes carried out would be transparent and that no harm would be done to any school, parent or learner during the gathering and reporting of data.

1.6.2 DATA COLLECTION

Surveys (see Appendix E) based on three questionnaires were answered by the sample of 541 Grade 10 learners. These questionnaires were, as mentioned, based on the three variables of interest originating from the research questions. Part B of the survey constitutes the questionnaire on learner choice satisfaction regarding post-compulsory PS, part C the PSE-questionnaire (Love, Dea Moore, & Hensing, 2012) and part D Ruswa's questionnaire about BROE (Ruswa, 2015).

The PSE-questionnaire is an internationally validated instrument, comprised of ten four-option Likert type questions. Ruswa's scale was initially developed for higher education and therefore needed to be adapted for Grade 10 learners. This adaptation process involved a pilot study which I discuss in Chapter 4 (see 4.3). Grade 10 learners answered this questionnaire comprised of a selected amount of five-option Likert-type questions. Data on choice satisfaction were collected by making use of a 10-option Likert-type questionnaire which I developed, specifically for the purposes of this study. This questionnaire is comprised of four questions about the importance, usefulness, advantage and benefit of the learners' current subject choice regarding PS.

A large amount of numerical data were collected, therefore the generalisability of the findings is expected to be high (Plowright, 2011). On the one hand, not much in-depth data can be collected by means of surveys (Plowright, 2011), but, on the other hand, the data collected can be used to identify matters of concern which could be the topic of investigation for other studies (Unterhalter & Walker, 2007).

1.6.3 DATA ANALYSIS

Data from these surveys were analysed statistically by Prof Robert Schall from the Statistical Consultation Unit at the UFS. SAS was used as analytical software tool to do correlation and regression analysis (SAS Institute Inc, 2016).

The following domain averages of the Likert scale responses (see Appendix E) were calculated:

- Choice satisfaction

- PSE
- Basic opportunities in education (BROE)

In order to gain perspective regarding the background of the data set, some descriptive statistics on PSE and choice satisfaction were calculated and in exploring the various study objectives, the following simple and multiple regression analyses were done:

1. Regression of choice satisfaction against PSE
2. Regression of choice satisfaction against PSE and BROE

In the multiple regression models, the biographic factors were fitted as potential confounders.

1.7 OVERVIEW OF CHAPTERS

Chapter 2 constitutes the literature review, describing the decline of post-compulsory uptake of STEM-related subjects, as well as the different groups of factors influencing the decline of learners who study STEM subjects at national as well as international levels. The focus narrows down to one group of factors, namely individual factors, with self-efficacy as an internal factor influencing the choices learners make at post-compulsory level. Self-efficacy, from SCT, is an under-researched factor in post-compulsory STEM education. Chapter 3 proceeds to the theoretical framework by making use of Amartya Sen's Capability Approach. I use the CA, a person-centred approach, as a framework to incorporate self-efficacy as a personal conversion factor, into developing a conceptual framework *perceived power*. Given my claim of perceived power's usefulness in the context of PS education, I pose research questions which I answer, guided by methodology described by Plowright (2011). The methodology, described by Plowright (2011) is explained in consecutive chapters. In Chapter 4, sampling, data collection and analysis of data are discussed. Attention is also given to limitations, ethics, validity and reliability. In Chapter 5 evidence about the analysis of data is given and claims made throughout the thesis are explained in terms of the data. In Chapter 6 I summarise the findings, indicate suggestions and show how knowledge gained about PSE as a personal conversion factor towards learners' choice satisfaction regarding post-compulsory

PS, contributes towards knowledge development in the field of education, specifically towards theory building in the CA, as well as new numerical evidence towards theory building in the CA.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter I review research on learners' choice to take PS beyond the compulsory level, and four groups of factors which affect this: Systemic; School; External; Individual. PSE, an individual factor, is the focus of this study. In this chapter I will therefore direct attention towards literature regarding SCT of which PSE forms a part. PSE is known to affect the choices people make (Bandura, 1994). I further explore the CA as a framework in explaining how satisfied people are with their choices, and the impact of their choices on their wellbeing.

2.2 POST-COMPULSORY UPTAKE OF PHYSICAL SCIENCES

Locally (Department of Basic Education, 2016) and internationally there has been a decline in the number of learners who take Physical Sciences beyond the compulsory level (Bennett, et al., 2011). This is problematic since it impacts on the number of people pursuing careers in the field of STEM, which is important for the progress of a country. The United Nations' Human Development Goals 1–3 and 6–9 link directly to people pursuing careers in the field of STEM, and therefore also post-compulsory Physical Sciences education (HDR, 2016). It seems reasonable to assume that the enrolment of students in PS courses could help in the attainment of the United Nations' development goals such as food security, good infrastructure, accessible energy resources, available and sustainable water and sanitation – to name but a few.

2.2.1 DECLINE IN POST-COMPULSORY UPTAKE OF PHYSICAL SCIENCES

The strategic plan towards 2020 of South Africa's Department of Basic Education encourages more learners to enrol in Physical Sciences, since the development of human capital lies central to any country's economic growth (Department of Basic Education, 2016). Unfortunately this aim is not being met, as seen by the decline in PS learner enrolment from 2014-2017, as well as the poor retention figures from grades 10 to 12 (Table 2.1). The data shown here is only for the Free State province, although these trends apply to the country as a whole (Department of Basic Education, 2016).

Table 2-1: Learner enrolment of Physical Sciences in the Free State (EMIS, 2017)

2017		2016		2015		2014	
Grade	No of learners	Grade	No of learners	Grade	No of learners	Grade	No of learners
10	17828	10	19153	10	21296	10	19916
11	11739	11	12497	11	13040	11	13800
12	9264	12	9071	12	10353	12	8894

This problem with the declining uptake of PS presents itself as an international trend towards a drop in the uptake of Science subjects. In England a decline in the uptake of A-level Physics and Chemistry over the 20 years prior to 2013 has been reported (Bennett, et al., 2013). Australian researchers also recognises the problem by focusing on factors influencing uptake (Spence & Albion, 2013).

2.2.2 FACTORS INFLUENCING POST-COMPULSORY UPTAKE OF PHYSICAL SCIENCES

From literature it seems clear that learners' choice of selecting PS or not, can be linked to one or more groups of factors. These factors are discussed below.

2.2.2.1 Systemic factors

Bennett, Braund and Sharpe (2013) propose a relationship between systemic factors and uptake of STEM subjects at the post-compulsory level. Examples of systemic factors which affect PS choice include Cost; Amount of entry points into a STEM related field of study; Early specialisation into STEM as opposed to broad-based programmes; and the Management of educational system. For example, lower cost programmes with a broad base are more favourable to uptake than early specialisation with few other entry points, which leads to a decrease in uptake (Bennett, et al., 2013).

The education system in South Africa is managed in such a way that public schools are segmented into five quintiles according to Socio-Economic Status (Department of Education, 2003) regarding subsidies received from government. Quintile 1 represents the poorest and quintile 5 the richest. As described by the S*chool Funding Norms* of the Department of Education (2003), a 35-25-20-15-5 distribution of funds should be followed across quintiles 1 to 5. This implies that school fees across the quintiles vary and that, in general, as Spaull explains (2012), top quintile schools remain inaccessible to learners from lower socio-economic backgrounds. In their Annual Performance Plan, the DBE mentions that 12% of South African learners paid school fees of more than R3 000.00 per month in 2016 (Department of Basic Education, 2018). During 2016 the basic monthly salary in South Africa was R2 500.00 (WageIndicator, 2018). The large gap between this basic salary and the school fees paid by 12% of the population illustrates the large socioeconomic spectrum of the South African population and implies the resultant differential quality of education received. Cost is one socio-economic factor which excludes learners from lower socio-economic status from enrolling into higher quintile schools. In South Africa a prominent trend is detected of higher quintile schools performing much better than lower quintile schools (Department of Basic Education, 2016). This trend is also mentioned by Juan, Hannan and Namome (2018) in their research on the influence of self-efficacy on Grade 9 learners' performance. Of concern in South Africa is that higher quintile schools are usually also those with better results on the National Senior Certificate (NSC), Trends in International Mathematics and Science Study (TIMSS) and Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ IV) (Department of Basic Education, 2018). It is clear that learners from higher quintile schools are exposed to better educational opportunities than learners from lower quintile schools, and this surely contributes significantly to the differential academic performance of learners from these two groupings.

In South Africa, learners are formally exposed to Science in the curriculum from Grade 4, that is age 10, to Grade 9 (Department of Basic Education, 2013). During this six-year period the Natural Sciences learning area offers a combination of Physics, Chemistry, Geography and Life Sciences. The aim with this programme is teaching learners a variety of skills, and to expose them to experiences which might be valuable for learners in acknowledging their own strengths and weaknesses regarding some choices they have to make in Grade 9 towards

post-compulsory education in Grade 10 (Department of Basic Education, 2013). Post-compulsory Physical Sciences, in Grade 10, may be offered as a combination of Physics and Chemistry in all public schools up until Grade 12 (Department of Basic Education, 2013). On completion of Grade 12, learners write the National Senior Certificate (NCS) to accumulate credits towards selection for tertiary studies as stipulated by the South African Schools Act No. 84 of 1996 (Republic of South Africa, 2013). Although some tertiary institutions do offer extended access programmes, specifically also in STEM-related studies, Grade 10 can be seen as critical regarding access to STEM-related tertiary studies. Extended tertiary access programmes benefit numerous students, but expense can be prohibitive.

Systemically, South Africa's schooling system appears to provide ample opportunity towards the uptake of PS, since government does provide funding, especially towards the so-called Science Maths and Technology (SMT) schools (DBE, 2018). The South African programme is also broad-based, teaching Science from Grade 4. Literature, though, indicates a definite decline in uptake, as seen in 2.2.1. The identification of problems within the SA system may be enhanced by reporting on the performance of performing and under-performing schools separately, as suggested by Spaull (2012).

2.2.2.2 School factors

School factors are a significant, multifaceted group of factors which, in my experience as a teacher, without a doubt affect learners' opportunities regarding the uptake of PS. School factors affecting PS choice, while contributing toward progress in the South African schooling system include the specific curriculum offered by the school, demographic factors of the school, opportunities offered by the school to engage with the world of science, appreciation of the possibilities brought about by a qualification in STEM, performance and accountability of specific teachers employed by the school, and the ease or difficulty experienced by learners in transitioning from one phase to another (Bennett, et al., 2013). This difficulty experienced by learners in transitioning from one phase to another can be eased when the teacher and the learner accept mutual accountability for learning (Spaull, 2013). A school factor which can affect PS choice and should receive more attention in the South African context is the competence and capacity of school principals (Spaull, 2013).

The relationship between the various school factors and systemic factors are give-and-take in nature. For example, I explained under *systemic* factors that the specific curriculum offered by South African public schools is managed by the *DBE* on national level (Department of Basic Education, 2013). Provided opportunities beneficial to learning, it is conceivable that its successful implementation depends on factors such as the availability of teachers and textbooks, the effective management of funds and a workable timetable – all of which depend on the competence and capacity of school principals (Department of Basic Education, 2016). The competence and capacity of school principals are illuminated by Spaull (2013) as factors contributing towards the quality of education in South Africa. It becomes evident that South African schools are confronted with complex problems. One example is that principals' capacity is in a sense being restricted by the DBE, yet the DBE expects their schools to perform well in benchmark assessments such as NSC, TIMSS and SACMEQ (Department of Basic Education, 2018).

International research suggests that demographic factors might influence the uptake of Science-related subjects at post-compulsory level (Bennett, et al., 2013). In South Africa, the influence of demographic factors on post-compulsory uptake of PS is a complicated matter. Spaull (2012) suggests that demographic factors are partly responsible for some misinterpretations of statistical data in the South African educational system. Since South African schools can be described as having a twofold nature, averages overestimate the performance of the majority of SA learners. This twofold nature of SA schools can be explained by the current socio-economic status as a remnant of the pre-1994 political climate (Spaull, 2012). Schools performing well in national and international benchmark assessments like NCS, TIMSS and SACMEQ are usually geographically and financially inaccessible to learners from lower socio-economic strata. The DBE states in their Annual Performance Plan (2018) that 12% of South African learners between the ages of 7 and 15 walked to school for longer than 30 minutes in 2016 on a daily basis. This may reflect the willingness of learners to attend school, although exposure to the trauma and danger of possible physical abuse, attack or accidents should be considered for learners during such a long walk. Similar to cost, geographical inaccessibility is also a barrier to effective learning and may cause a large percentage of public schools to remain dysfunctional (Spaull, 2012). Dysfunctionality implies that the school is underperforming regarding national and international benchmark

assessments, and this usually has an effect on the post-compulsory uptake and the quality of passes in PS (Department of Basic Education, 2018).

Another school factor concerning the decrease in uptake of STEM subjects is that learners find the transition from one phase to another difficult (Bennett, et al., 2013). Seemingly teachers who are experts in science are able to assist learners during transitions, and can encourage uptake of STEM subjects such as Physical Sciences (Bennett, et al., 2013). Currently research groups are focusing on building the content knowledge as well as the skills of both student teachers and teachers. The body of knowledge on pedagogical content knowledge is already extensive and has international relevance on various topics of interest, for example whether skills and techniques acquired from learning specific content knowledge about electric circuits can be transferred to other topics (Mavhunga, Rollnick, Ibrahim & Qhobela, 2016). Similarly a body of knowledge on skills training and cognitive development of teachers and student teachers is having an impact on science education in Southern Africa, for example making use of electronic tutoring software to engage student teachers in deep learning towards specific content (Stott & Hattingh, 2015).

Current South African research addressing school factors have international relevance. One could argue that within the given groups of factors, ample research is being performed in areas which address school factors.

2.2.2.3 External factors

External factors are seen by Bennett, Braund and Sharpe (2013) as factors other than school factors that may influence the uptake of STEM subjects. These include leisure activities with a science focus as well as experiences of science in the media.

One such area is a body of knowledge which makes use of the collective term *science capital*. The focus of *science capital* is on informal activities contributing towards scientific knowledge. Such informal activities usually have their origin in socio-cultural activities. An example is when learners in rural communities are exposed to formal learning about the quality of water, where the learners can relate their acquired knowledge about water quality to everyday experiences about the quality of the water source in their community (Zimmerman & Weible, 2017).

One very pertinent body of knowledge, which attracts numerous international researchers in projects in this field, is IKS. IKS focuses on knowledge systems developed by communities, and for example its integration with the formal science curriculum (Taylor & Cameron, 2016). The Southern African focus on IKS has deep roots with widespread effects such as enhancing formal science knowledge by incorporating IKS into teaching pedagogies like argumentation (Ogunniyi & Hewson, 2008).

From a perspective of creating opportunities beneficial to learning for learners, there is no doubt that external factors impact the uptake of STEM subjects. The focus of this study is, however, on individual factors, specifically PSE increasing learners' individual power and as a consequence their real opportunities.

2.2.2.4 Individual factors

Individual factors affecting the uptake of STEM subjects include gender, socio-economic background, ethnicity, prior achievement in science, perceptions of subject difficulty and confidence in ability (Bennett, et al., 2013).

Some of these factors like gender, socio-economic background and ethnicity are continuously being researched. For example, females are seen as underrepresented in STEM fields. One example of a study where researchers focused on a strategy to increase female participation in STEM is from Social Psychology. In the study researchers explain that focusing on group dynamics can have an effect on both the intrapersonal and interpersonal experiences of women in STEM (Grover, Ito & Park, 2017). The fact is that learners and students from ethnic minorities and poor socio-economic backgrounds who experience marginalisation and exclusion regarding STEM-subjects cannot be overlooked, which explains the widespread international research focus on these factors. Another example is research on how social and psychosocial dimensions of STEM influence the way in which students connect their personal identities to their academic identities. In other words, persistent engagement in STEM might be enhanced through the implementation of student support programmes (Leggitt-Robinson, 2017).

One of the key bodies of knowledge in the literature in addressing the perceptions of subject difficulty and confidence in ability is *mindset*. In short, from a psychology point of view,

researchers investigating *mindset* focus on the phenomenon of people holding the belief that intelligence is not fixed but can be developed (Dweck, 2012). People with a *growth mindset* are open to attempt more difficult tasks, as opposed to persons holding a *fixed mindset*. Individuals holding a *growth mindset* are also less inclined to be overconfident and have better self-knowledge (Ehrlinger, Mitchum & Dweck, 2016). One study done in South Africa on *mindset* relates the effects of grit – or perseverance and self-discipline – and *mindset*, by investigating learners' performance on complex tasks (Kench, Hazelhurst & Otulaja, 2016). Grit, also from a psychology point of view, is defined as *perseverance towards especially long term goals* (Duckworth, 2017). In the mentioned South African study (Kench, et al., 2016), it was found that grit had a positive relationship with good performance on complex tasks, but the relationship between *mindset* and performance is still open for further investigation.

Another body of knowledge to address perceptions, is SCT, which encapsulates PSE. PSE has been the focus of several international and meta-analytical research projects in social and developmental psychology over four decades (Stajkovic, et al., 2018). Four processes are claimed to strengthen PSE: Mastery of experience; Vicarious experience; Social persuasion; and Physiological states (Bandura, 1994). Theorists from a SCT perspective claim that each person can control the four processes mentioned at the individual level. Individual control of these four processes is expected when a person perceives a certain level of control over their affective and physical experience of the environment, as well as a certain level of control over their own functioning and performance (Bandura, 1994). Some researchers doubt the theory behind PSE (Meichenbaum, 1990), but the empirical evidence presented by researchers from a SCT perspective are sound, both regarding the methods and design of studies (see 2.3 and 3.2.1). What discerns PSE from concepts like *mindset,* resilience and grit is the claim that PSE is strengthened by four processes, as mentioned, where each of the other concepts are strengthened by two or three processes only. *Mindset* is a belief system influencing willpower, which is mainly taught through vicarious experience and social persuasion (Dweck, 2012). Resilience focuses on wellbeing in the midst of an extremely negative environment (Fletcher & Sakar, 2013), while grit is explained by researchers to be a mechanism encompassing self-control and willpower, employing focused attention and emotions towards reaching one's goals (Duckworth, 2017). Researchers like Professor Angela Duckworth (2017) believe that a better understanding of self-control and *grit* could lead to

high-impact cost-effective interventions, and rightly so. In fact, there is evidence from the literature that Albert Bandura has been doing exactly these kinds of interventions on the basis of SCT since the 1970s (Bandura, 1977).

The fact that PSE is firmly rooted in SCT, with an extensive theoretical and empirical background, convinced me to explore PSE as an individual factor influencing post-compulsory PS uptake. Another persuading factor was the fact that PSE, in an educational context, is under-researched.

2.3 CONCLUSION

To conclude, there should be agreement that the decline in post-compulsory uptake of STEM is a problem which can be influenced from different fields of research. Most of the research from an educational perspective focuses on the tertiary uptake of STEM as a field of study, and teacher training. Prior to the tertiary uptake of STEM, the post-compulsory uptake on Grade 10 level should be illuminated. The post-compulsory uptake of PS is influenced by systemic, school, external and individual factors, where each factor is compiled of multifaceted components. An individual factor which can possibly have powerful effects towards the personal and interpersonal functioning of learners as well as facilitating learners towards increasing their opportunities, is PSE. The concept of PSE regarding post-compulsory uptake of Physical Sciences is also under-researched. The CA allows researchers within specific disciplines to formulate theories or frameworks towards practical problem-solving. In the next chapter of this study, I am creating a capability application from the perspective of the CA, which I expect to employ in my investigation of the effect of PSE on the post-compulsory uptake of Physical Sciences.

CHAPTER 3: THEORETICAL AND CONCEPTUAL FRAMEWORK

3.1 INTRODUCTION

In the previous chapter I discussed systemic, school, external and individual factors affecting PS uptake. In this chapter I am innovatively employing the CA in the context of post-compulsory PS education, to formulate a capability application (Robeyns, 2017) which I refer to as *perceived power*. *Perceived power* is my conception (conceptual framework) of how learners can employ their PSE to transform available opportunities, for example opportunities available in the educational context, and the opportunity of subject choice, into achievement of choice satisfaction, assessed in this study in the context of post-compulsory PS. Elements such as human diversity are also taken into account. This framework supports the investigation of my claim that PSE can function as a personal conversion factor (see 1.6) towards transforming the available opportunity of subject choice, in the context of PS, into post-compulsory choice satisfaction. Given that PSE is encapsulated in SCT, I employ SCT, in conjunction with the CA, to develop this framework. In the chapters to follow I do a numerical (quantitative) statistical analysis regarding the usefulness of *perceived power* and its potential to be employed in circumstances related to post-compulsory subject choice regarding PS.

3.2 THEORETICAL FRAMEWORK

An appropriate theoretical framework for this study is drawn from Albert Bandura's SCT and its three main concepts, namely triadic reciprocal determinism (TRD), agency, and PSE. In addition, I complement this theoretical framework with Ingrid Robeyns's interpretation of Amartya Sen's CA. My rational for working with Robeyns's interpretation of Sen is premised on her contribution towards making the CA more accessible and easy to employ in an interdisciplinary manner. As a former PhD student of Sen, Robeyns' scholarly work, "WELLBEING, FREEDOM AND SOCIAL JUSTICE: The Capability Approach Re-examined" (2017), contributes towards the inclusion of the CA, by means of various appropriate elements (see 3.2.2), in any capability theory or application. Each element, whether a core element or not

(Robeyns, 2017), is important for conceptualising whether learners have sufficient control over their environments to make choices they can be satisfied with.

In the subsequent sections I first describe Albert Bandura's SCT with specific reference to PSE, and secondly, I give an explanation of Amartya Sen's CA. These descriptions are followed by an explanation of my interpretation of how PSE can possibly fit into a narrow capability application (see Robeyns, 2017) to better our understanding about the post-compulsory choice satisfaction of Grade 10 learners in the context of PS.

3.2.1 SOCIAL COGNITIVE THEORY: ALBERT BANDURA

Researchers from a SCT perspective claim that humans are agents who intentionally influence their performance and life situations to benefit their wellbeing (Bandura, 2006). In this regard, individuals have the power to affect their wellbeing by selecting the opportunities they value most, through intentional practise of sound self-judgement mechanisms. While PSE is defined as the process of practising sound self-judgement (Bandura, 2009), the individual power of employing PSE changes lives, regardless of geographical distribution, culture, language, sex, age, socio-economic class, educational level or world view (Bandura, 2011). To name but one example, by employing the three main concepts SCT encompasses, it has been put to practise with great success in Sudan to tackle issues like the injustice of forced marriage, the risks of early childbearing, prevention of HIV infection, embroilment in drug activities and the widespread practise of genital mutilation (Bandura, 2011). As the individual power of employing PSE is subject to personal ethics, objectives and commitment, it has the potential to be directed towards self-centeredness; in other words as a form of power misuse. The misuse of individual power, however, should not be mistaken for the way intentional practise of PSE can improve the wellbeing of a person (Bandura, 2011).

The following discussion of the three main concepts of SCT, namely TRD, agency and PSE, clarifies how PSE activates TRD through agency. As PSE brings about agency, the level of PSE practised by a person is claimed as valuable in various situations towards their personal wellbeing and the wellbeing of their societies (Bandura, 2002).

3.2.1.1 Triadic reciprocal determinism

Synonymous with Bandura's SCT is the concept of TRD which he describes as mutual relations between cognitive processes (thought), physical and affective experience of the social environment (experience), and the quality and functioning of performance (performance) (Bandura, 1989). Bandura (2011) explains that people who consciously work towards what they value not only experience satisfaction, but change what they become in the process. Important to keep in mind, is that the mutual relations between thought, experience and performance do not occur simultaneously, and the strength of these relationships vary, depending on the specific task at hand (Bandura, 1989). In the subsequent discussion the focus is placed on the effect of the mutual relations on the other; in other words how thought, experience and performance might influence each other, including their varying strength within TRD.

a) Thought

People transform information which is attained through focused attention into abstract form: thought. As a result, thought is integrated and put into practise (performance) to improve the quality of their functioning and performance (experience) (Bandura, 2002). These improved performances alter the experience of the physical and affective environment to such an extent that the mutual relationship with thought patterns are strengthened (Bandura, 1989). Within the concept of TRD, the bidirectional influence of processes on each other is evident. The latter can be understood by acknowledging the influence of thought on initiating new experiences that lay the foundation for a better quality of performance, or by thought's influence on adapting performance in such a way that experience is changed in favour of wellbeing (Bandura, 1989). Thought can therefore either influence experience with changed performance as outcome, or influence performance with altered experience as outcome.

Sharp and Miller (2018) explain that a mechanistic approach is useful to describe relationships with alternative outcomes in a practical way. A mechanistic approach for describing alternative outcomes could imply a sequential description of multiple influences by separating outcomes by time, or a separation of outcomes by space in dividing complex matter into subsystems. Bidirectional influences can therefore be simplified when separating outcomes sequentially (by time) and spatially (into subsystems) (see 3.2.1.4).

b) Experience

The nature of the *socially experienced environment* is created by a selection of social and physical conditions (Bandura, 1989). For example, physical features of people, like age, race, and sex, induce a particular social bias or experience. People's physical characteristics bring about certain reactions towards them, even before they get a chance to prove their worth through their performance (Bandura, 1989). Applying a mechanistic approach is appropriate, since a multiplicity of effects map out distinct environmental experiences similar to other bidirectional influences, in terms of time and space (Sharp & Miller, 2018).

Bandura (1989) explains that people can choose to belong to particular social groups or to attend specific social events, and in the process opt for exposing themselves to experiences which encourage certain physical or affective reactions. The wellbeing of people is influenced by individuals' reaction and personal experience of their social environment. The way people react towards their social environment, influences their personal experience of this environment. Yet, people's personal experience of their social environment influences their reaction towards that environment. People's reaction towards their environment can be either through thought or performance, thus another bidirectional influence which becomes clearer when mapped out in a mechanistic way, as suggested by Sharp and Miller (2018).

c) Performance

Over his lifetime, Bandura has researched human behaviour and succeeded in shifting the research focus from studying peoples' *behaviour* to looking into the *quality of functioning* and *performance* of humans (2002). People's functioning and performance are responsible for their experiences, whether on affective or physical levels, and these experiences create opportunities to judge personal competency (Bandura, 2002). When people's own performance plays a pivotal part in the experiences they value and enjoy, they judge themselves positively. Not being satisfied with an experience they value, encourages them to improve on the quality of their performance in order for the next experience to contribute more towards their wellbeing. Without attributing personal value to an experience, people might refrain from taking part in similar experiences in future to avoid judging themselves negatively (Bandura, 1989). One can expect that a multiplicity of probable performances could leave people satisfied with, and valuing, their own experiences. Each probable

performance could lead to a different possible enjoyable experience. However, people might be satisfied with one specific performance directing them towards one specific valued experience, and never explore alternative experiences which could guide them towards even better wellbeing (Bandura, 1989).

To summarise, it can be said that, through the concept of TRD, the mutual and bidirectional influences of thought, experience and performance on each other are explained. These bidirectional influences on each other could be complex to decipher, and a practical way of simplifying multiple outcomes from several influences is to separate outcomes sequentially and spatially. In this regard, a mechanistic approach as suggested by Sharp and Miller (2018) can be considered. Likewise, this mechanistic approach can be employed to clarify the influence of concepts involved in the TRD-concept, such as agency and PSE, on processes like thought, experience and performance.

3.2.1.2 Agency

In general, the concept of human agency is employed as widely as anthropology, criminology, the CA (see 3.2.2.7), sociology and psychology. From the perspective of SCT, as agents, people influence their environments by means of performance, and also accept feedback from their respective environments to adjust their performance accordingly (Bandura, 1989). As agency impacts on TRD at the level of performance, it can influence all processes forming part of TRD. Bandura (2002) explains that people can employ agency to influence their environment by exercising performance on one of, or on all three distinct levels, namely individual, proxy, and collective. While performance can transform thought into new experiences and action, the level of employed agency depend on specific demands of performance (Bandura, 2006). In the subsequent paragraphs I focus on the distinction between the levels in which agency can be employed.

People employ *individual agency* when they exercise direct control over personal performance in order to enhance valued experiences (Bandura, 2006). The value of an experience might lie with an individual, or with a group that a person belongs to. The level of agency employed is, however, only individual provision that an individual exercises direct control over personal performance to enhance the experience.

Bandura (2006) explains that according to SCT, *proxy agency* is exercised by people when direct control to enhance performance and functioning is not possible. People then encourage those with valued knowledge or resources to act on their behalf to better their performance and functioning, or to better the performance of the group that they belong to. Improved performance subsequently results in more valued experience(s).

People from an individualistic culture employ *collective agency* by pooling their knowledge, resources and skills in enhancing the performance of an individual person towards a common, valued goal. In the same way, people from a collectivistic culture employ collective agency to enhance the performance of a group of people towards a common, valued goal (Bandura, 2006).

Agency, whether on the level of the individual, proxy or collective, is activated by the third and central concept to SCT, PSE. The three concepts forming part of SCT (TRD, agency and PSE) are seen to be interactive, with PSE being central to SCT in the sense that PSE drives agency, which in turn impacts on TRD (see 3.2.1.1).

3.2.1.3 Perceived self-efficacy

Forming the focus of this study, PSE has been identified by Bandura (1977) as a central concept to SCT and acts as a driving force to motivate intent or agency (see 3.2.1.2; Bandura, 2006). In addition, Bandura (2009) defines PSE as the personal belief in one's competence to cope with future situations. He (Bandura, 2009) further explains that beliefs regarding one's competency in managing diverse situations are developed independently from culture. Both theoretical and empirical evidence suggest the benefits of developing a high level of PSE; in other words the benefits of truthful self-judgements and self-belief towards human wellbeing (Bandura, 1989; 2011). The quality of human life in general is subject to transformation once a high level of PSE has been developed.

In developing PSE, it is important to understand that there are distinct operations involved when people judge their individual PSE (Bandura, 2009). Participation during any event, either actively or not, implies that sensory information is conveyed to a person. Acquiring sensory information does not mean that accurate self-judgement or PSE is developed. Rather, two distinct operations are needed to develop PSE, namely the selection and interpretation of

information, and the integration of information into PSE judgements (Bandura, 2009). Also, according to Bandura (1994), four processes are involved in strengthening PSE, namely social persuasion; vicarious experience; mastery of experience; and physiological states. A better understanding of how these processes operate can be used to inform the development of high impact, cost-effective interventions (Bandura, 2009), similar to what Professor Angela Duckworth has in mind regarding *grit* (2017; see 2.2.2.4).

PSE can only be assessed in specific contexts since people do not judge themselves in a 'general' context, but rather by focusing on specific sensory information in specific situations (Bandura, 2007). In the context of this study, I argue that the PSE of Grade 10 learners is assessed in cases where they adapt to the post-compulsory uptake of the subjects they chose in Grade 9. This is therefore a situation in which they have to adapt to some associated difficulties that accompany the novelty of the new grade and subject (see 4.6.1). A firm empirical knowledge base suggests that PSE affects the choices people make, for example female students with higher PSE are more likely to consider a career in engineering than females with lower PSE (Johnson & Muse, 2017). As research confirms that higher levels of self-efficacy links to higher levels of engagement and participation in STEM, the focus of this study is to contribute specifically to literature regarding theoretical and empirical links between self-efficacy and the post-compulsory uptake of Physical Sciences (see Bennett, et al., 2013).

3.2.1.4 Effects of agency and perceived self-efficacy on the processes of Triadic Reciprocal Determinism

TRD constitutes three processes, namely thought, experience and performance (see 3.2.1.1). While all three of these processes are bidirectionally influenced by the other, each process is also influenced by agency. Thus, to conceptualise the different influences of the three processes on each another and of agency on each process, it is important to consolidate ideas at this point.

According to TRD, thought, experience and performance interact with each other in a specific context and is expected to show simultaneous interaction with processes involved in concepts such as agency and self-efficacy. Given that both agency and self-efficacy are concepts with various possibilities towards assessment and interpretation (see 3.2.1.2 & 3.2.1.3), during

simultaneous interaction of processes such as thought, experience and performance, each of these concepts are expected each to be assessed and interpreted on different levels. Thus, the expectation is that the level of assessment as well as interpretation of agency differs in relation to the specific context that self-efficacy is assessed in (see 3.2.1.3). In the same way, it can be expected that the assessment and interpretation of self-efficacy differs in relation to the level of agency assessed. It is therefore said that agency and self-efficacy can influence each other bidirectionally, and that how a researcher interprets each of these concepts depends on a specific pattern of TRD described by the researcher. Sharp and Miller (2018) suggest that in order to enhance our understanding of complex patterns in specific contexts of interest, like these influences between processes that can imply a different interpretation regarding a specific concept, patterns should be described simply and mechanistically. Figure 3-1 is a representation of a spatial separation of theorised relations between PSE, agency and the three processes encapsulated in TRD. I claim that this spatial separation pattern can improve our understanding of different possible outcomes when more than one process influence the other. Researchers should be able to interpret these alternate outcomes in terms of concepts with alternate possible influences on each other. The fact that the mechanistic approach (see 3.2.1.1, a) is, in my mind, employed as a mechanical spatial separation pattern, is purely descriptive. With this I have no intention of implying that mechanical mechanisms are at play. Patterns of bidirectional influences between thought, experience and performance are merely simplified by means of a mechanical spatial representation.

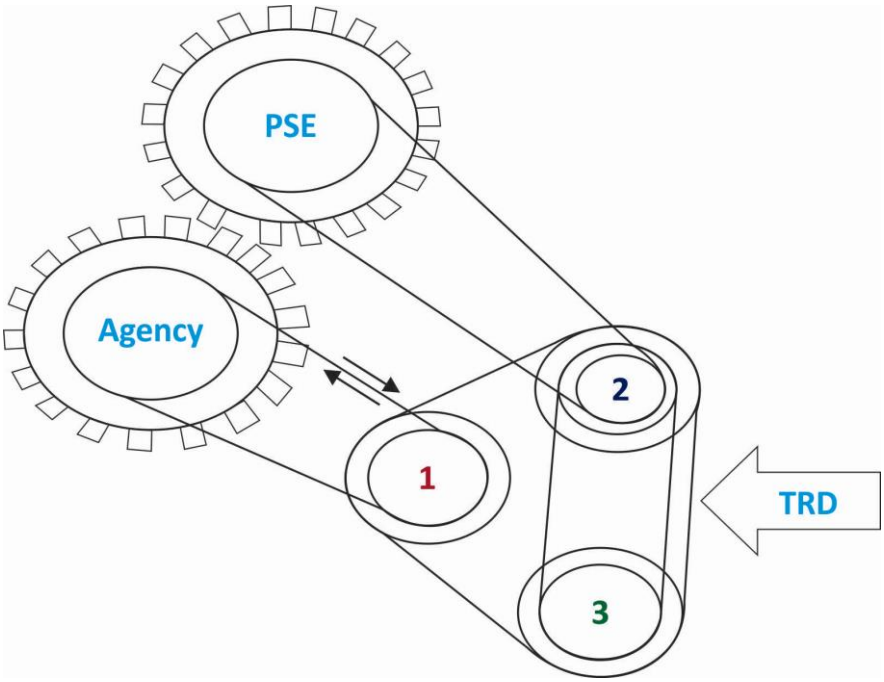

Figure 3-1: Simplified diagram about some effects of agency within triadic reciprocal determinism (drawing: Francisco Fourie, 2018)

My claim is that Figure 3-1 can be interpreted in terms of separate mechanisms, each with the origin as one of the three factors key to TRD, namely thought, experience, and performance. In Figure 3-1 each of the three key factors are represented by a number: **2. Thought**; **3. Experience**; **1. Performance**. The numbering and order is purely descriptive and each mechanism, through the appropriate application of agency, independently affects human wellbeing towards a life of value (Bandura, 1994). In the paragraphs to follow I describe three possible patterns that can be expected to emerge from interactions between PSE in terms of the specific level, the level of agency employed, and the processes involved in the TRD concept.

One pattern that emerges when outcomes are separated spatially, is the **performance-experience-thought**-pattern (Bandura, 2006). By performing actions people create experiences, whether affectively or physically. People with well-developed PSE employ appropriate levels of agency of an experience through cognitive processing to repeat the **performance-experience-thought**-pattern (Bandura, 2006; see Figure 3-1). I expect that in their repetition of this counter-clockwise pattern of **performance-experience-thought** (from

nr.1 to nr.3 to nr.2), people intentionally pursue specific value(s) to improve their wellbeing (Bandura, 2006).

Similarly, I expect that by spatially separating outcomes, another pattern can emerge when people with an opportunity to new experience(s), process these experiences cognitively before taking action. In Figure 3-1, this **experience-thought-performance**-pattern is indicated by sequencing the numbers 3, 2 and 1, counter-clockwise. I expect people with high PSE to employ an appropriate level of agency in order to intentionally improve the **experience-thought-performance**-pattern towards improving their wellbeing (Bandura, 2006).

Correspondingly, I expect that it is possible for a pattern of **thought-performance-experience** (see Figure 3-1), indicated by a counter-clockwise sequencing of the numbers 2, 1, 3, to originate cognitively. Such a pattern can be expected to lead to specific performance outcomes that expose people to more experience(s). By employing an appropriate level of agency, experience can be supported in repeating the particular **thought-performance-experience**-pattern (Bandura, 2006). Important to note is that the origin of each of these patterns depend on the availability of opportunities and on whether agency is employed. People with high self-efficacy are able to employ agency more effectively on a level appropriate to the required performance (see 3.2.1.3).

The latest research on self-efficacy is a meta-analytic path analysis on the influence of efficacy, openness to experience, conscientiousness, extraversion, agreeableness and neuroticism on performance. In this regard it was found that high levels of conscientiousness (or the desire to do a task in an efficient and organised manner) and emotional stability in people predict a well-developed PSE (Stajkovic, et al., 2018). Therefore, a well-developed PSE is claimed to predict high levels of performance. Two recommendations are evident from this high profile study: students can use the power of their efficacy beliefs to aid their functioning and to be useful in the social context; and theory should focus on the integration of and commonalities between theories instead of conceptual segregation (Stajkovic, et al., 2018). If efficacy-beliefs are to be used in aiding the functioning of students, an investigation about the usefulness of PSE as a factor in transforming available opportunities into achieved opportunities seems viable. As I explain in the next section, this implies that PSE can, from a CA perspective, be perceived as a personal conversion factor (Robeyns, 2017).

3.2.2 CAPABILITY APPROACH: AMARTYA SEN

The CA is a people-centred research approach that originated from Economics, as an alternative to "gross domestic product" (GDP). GDP is an income-based metric which establishes the wealth of a country based on income; opposed to this, Amartya Sen (1965) reasons that the wealth of a country lies in the well-being of its people. Based on Sen's reasoning, the CA, as research approach developed. As a research approach, the CA is concerned with the individual wellbeing of the people by focusing on the opportunities available to each person. Martha Nussbaum encourages the development of social justice from a CA perspective, by protecting the opportunities of the poor and vulnerable (Nussbaum, 2011). She (Nussbaum, 2011) agrees with Sen's teachings (2000) that people who have sufficient power to access opportunities available from their environments can choose who they want to be and what they want to do. People are offered different choices, since all environments do not offer equal opportunities to everybody, and all people do not have the same level of power to access available opportunities from their environments.

Given that the CA was developed from assessing people's available and realised opportunities in the field of Economics, to evaluating people's opportunities regarding issues of social justice, into an interdisciplinary approach favouring a life of quality for all (Sen, 1992), Robeyns (2017) points out the generalisability of the CA. As an integrated approach the CA can be employed to, amongst others, assess people's individual levels of achieved wellbeing (having accessed available opportunities) and wellbeing freedom (their level of power towards accessing these available opportunities) in various fields of interest. Although it is not always possible to assess people's level of power towards accessing available opportunity sets accurately, individual performances can be assessed (Robeyns, 2017). In the absence of a direct link between the level of performance and available opportunities, uncertainty arises. In this regard, theorists from a CA perspective see conversion factors as personal, social or environmental resources that transform available opportunities into realised opportunities or performance.

Regarding the generalisability of the CA, Robeyns (2017) explains that broad capability applications can be developed into evaluative frameworks similar to what Nussbaum (2011) has done when she incorporated, as part of a powerful theory of justice, a list of ten basic

opportunities that she believes every person should have access to. Opposed to these broad applications, narrow capability applications can be formulated in order to gain information regarding specific topics. Researchers like Walker and Unterhalter (2007) drew from the work of both Sen and Nussbaum in arguing that education should be seen, from a CA perspective, as an opportunity towards decreasing social injustices and increasing individual wellbeing. Mathebula (2018) employed the CA to focus on engineering education and states that the goal of education, from a CA perspective, is to expand people's agency, which would empower them to pursue the goals they value in terms of their own wellbeing.

My aim is to formulate a narrow capability application to gain information about post-compulsory PS choice satisfaction. The focus is therefore on investigating the possible application of PSE as a personal conversion factor. Should it be possible for PSE to be employed as a personal conversion factor, it is conceivable that more power can be transferred to a learner in accessing opportunities regarding subject choice. A learner can therefore consider making subject choices based on his or her own personal values. In this regard, an opportunity for learners on Grade 10 level might be uncovered with regards to being satisfied with the choice(s) they have made in Grade 9, specifically regarding PS. By incorporating PSE as a construct from SCT into the CA as a possible personal conversion factor, a simplified application towards learner opportunities might emerge. When a capability application, whether broad or narrow, is formulated, some elements of the CA, which Robeyns (2017) term "modules", should be respected. Given that my aim is to formulate a narrow capability application to gain information regarding post-compulsory PS choice satisfaction, some of these elements are discussed in the paragraphs below.

3.2.2.1 Available opportunities and achieved opportunities are central and value-neutral concepts

Robeyns (2017) explains that in terms of the CA, it is important to conceptualise what people can really do and be, and what their actual achievements are. In order to conceptualise whether learners have sufficient control over their respective environments and are able to make choices they value, a number of core elements should be respected. Once the claim is made to develop an application from a CA perspective, as in this study, 'capabilities' and 'functionings' should be respected as core concepts (Robeyns, 2017). For the purposes of this

study, I am accepting the latest terminology in this regard, namely "available opportunities" and "achieved opportunities". In order to try and form an understanding about Grade 10 learners' post-compulsory PS choice, I conceptualise the available opportunities of these learners as the learners' basic realised opportunities in education (BROE). A list of BROE, and at the same time a questionnaire that numerically measures BROE, was developed by Anesu Ruswa from the work of Melanie Walker and Merridy Wilson-Strydom (Ruswa, 2015). Ruswa's questionnaire measures the level of a learner's achieved opportunities (employing the available opportunities) in education, as set out in Table 3-1.

Table 3-1: List of basic realised opportunities in education, adjusted from Ruswa (2015)

Achieved opportunity	Opportunity achieved in terms of: / example of item in questionnaire:
Educational resilience	I cope well with academic pressure and challenges
Learning disposition	I speak the language of teaching and learning of my school fluently
Physical health	I feel that my health does not limit my daily activities
Physical integrity	I feel safe on the school ground during school time
Senses, imagination & thought	I use reasoning to think about my values and beliefs
Emotions	I do not fear learning situations
Practical reasoning	I find it easy to solve problems which I did not anticipate
Affiliation	I respect, value and appreciate other people
Leisure	I participate in sport activities at school

In this study I expect BROE, as educational opportunities, to be achieved to some extent by a learner (indicated by the numerical assessment of BROE in 4.5), indicating its availability to that learner. In this study, the achieved opportunity I am assessing, is choice satisfaction regarding post-compulsory PS; while available opportunities are seen as BROE, and the availability of PS as one of the subject choices the learner had access to in Grade 9. Whether learners are satisfied with the choice of NOT being in PS, or satisfied with the choice of being IN PS, is not the concern. Of concern is whether a learner is satisfied with the choice he or she made, since the consequence of the choice is expected to affect the quality of that learner's life. Also, regarding issues such as choosing PS and not choosing PS, Amartya Sen (1992) warns that one should take care not to simply classify learners into two categories, such as 'taking PS is good' and 'not taking PS is bad', or vice versa. Sen is adamant that researchers should form a deeper understanding and refrain from considering categories like these as dichotomous. This thought of Sen is aptly summarised by Ingrid Robeyns (2017) when she explains that opportunities that seems valuable on one level, might on another level deliver harmful achievements. It is important to differentiate between available opportunities and achieved opportunities on two levels, namely the specific opportunity or achievement being investigated, and the value attributed to this opportunity or achievement, albeit by taking into consideration that opportunities and achievements cannot be *all good* or *all bad.* For example, the opportunity to take PS at post-compulsory level might be valued by a community of low socio-economic status since it presents itself with an opportunity towards bursaries for tertiary studies and future jobs of high income. The part of this opportunity set that cannot be ignored is the fact that taking PS requires long hours of studying and a level of problem-solving skills which needs a high level of dedication and commitment from the learner (Free State Department of Education, 2018). Some individual learners might value opportunities other than spending hours studying to possibly earn a high income in future. Learners should have the power to choose according to their own values and have the opportunity to experience choice satisfaction, since their choices will, in the end, determine their life trajectories (Bandura, 2011) and influence the lives of those around them (Walker, 2014).

3.2.2.2 Conversion factors

A core element from the CA that forms a key component in this study, is conversion factors or factors that determine the extent to which a person can transform available opportunities into achieved opportunities (Robeyns, 2017). Conversion factors can take on three forms, namely personal, social and environmental. Since minimal resources are needed to build strong PSE, a better understanding of PSE as a personal conversion factor can lead to high impact, cost-effective interventions (Bandura, 1994). This study investigates PSE as a factor converting the opportunity of post-compulsory PS choice into achieved choice satisfaction regarding post-compulsory PS. In other words, the claim that learners possessing high PSE would be more likely to experience better choice satisfaction with either their uptake of PS at the post-compulsory level, or with the fact that they did not take up PS on the post-compulsory level, is investigated.

3.2.2.3 The distinction between means and ends

Means and ends are more core elements from the CA that deserves attention. From a CA perspective, ends are seen as those opportunities to which people attribute an ultimate value (Robeyns, 2017). Regarding this study, I claim that an ultimate value can be seen as experiencing satisfaction about a choice that was made.

Other opportunities that need to be achieved in order for people to achieve an ultimate value, are seen as means to ends. Multiple different means or factors of instrumental value such as BROE in this instance, might eventually accomplish the same end (Robeyns, 2017). Robeyns (2017) explains that one needs to keep in mind whether enabling circumstances are in place for people to achieve the opportunities they truly value, and whether they have the means to the ends they want to reach. In the context of this study, my interest centres on whether Grade 9 learners have the means to choose subjects according to their individual values. As I have explained, in this context, an end is expected to be Grade 10 learners being satisfied with their subject choice regarding PS. One of the means can possibly be claimed to be learners' individual power to choose a subject they personally value. Researchers like Elaine Unterhalter and Melanie Walker (2007) who have done work locally as well as internationally on opportunities in education, state that most of the time in education, the power does not lie with the learner, and learners subsequently do not have the freedom to choose the

opportunities they truly value. As the aim of this study is to look at the possibility of a high PSE enabling learners to realise a specific opportunity of value to them, it is my aspiration to contribute towards increasing learners' means towards a valuable end.

3.2.2.4 Boundaries towards evaluation of opportunities

Another core element of the CA that needs to be respected is the evaluation of opportunities. Since the CA is seen as being normative, capability theories and applications require value judgements in terms of *good* or *bad* regarding the extent of freedom people have to achieve the opportunities they value (Robeyns, 2017). Robeyns (2017) explains that these value judgements cannot be understood in isolation, but should rather be considered in terms of the boundaries of opportunity sets. For example, a learner might struggle to pass Natural Sciences in Grade 9 but discovers that he or she has a passion for Chemistry specifically. This learner's family is supportive and she is not responsible for many chores around the house, implying that extra time can be spent on school work. Her opportunity set gives her, if the choice is valued, the freedom to choose PS at post-compulsory level. On the contrary, another learner might obtain above 90% in Grade 9 for Natural Science but have no interest in Natural Sciences, instead showing a passion for the arts. This learner's family might be from a low socio-economic group who values occupations like engineering and medicine, and where bursary opportunities are plentiful. It becomes clear that the second learner's freedom to choose the opportunities she values, might be limited in terms of her opportunity set.

3.2.2.5 Other elements of ultimate value

Some aspects other than available and achieved opportunities might be relevant towards accessing opportunities of ultimate value. These aspects might be, for example, the procedures used to either accumulate opportunity sets or achieve valued opportunities. Procedures that contribute towards achieving opportunities are seen to carry instrumental value (Robeyns, 2017). For example, Grade 8 and 9 learners need to be equipped with some skills needed to deal with the transition from Grade 9 to Grade 10. Some of these skills, specifically in transitioning from Natural Science to PS, for example include the organising of data in data tables and analysing data for trends and patterns (Free State Department of Education, 2018). Policy and procedure ensuring that sufficient skills can be taught (see Free

State Department of Education, 2018) should be seen as having instrumental value towards Grade 10 learners realising the opportunity towards a satisfying post-compulsory PS choice.

3.2.2.6 Value pluralism

Valuable opportunities and achievements, as other core elements to be respected, are conceptualised as those opportunities and achievements contributing to a person's wellbeing (Robeyns, 2017). Both opportunities and achievements can be described on multiple levels if the complexity of human nature is understood and accommodated well enough. People for example need available opportunities on physical, educational and social levels in order to live a quality life and achieve wellbeing. The focus of capability researchers can be on one specific available or achieved opportunity affecting wellbeing. It is however essential to the CA's contribution to our knowledge that these researchers should not lose sight of the contribution of other valuable opportunities towards wellbeing. The fact that the CA acknowledges all opportunities contributing to a person's wellbeing as valuable to that person, distinguishes the CA from resource-based approaches and mental metric approaches which tend to interpret human wellbeing in terms of one dimension only (Robeyns, 2017). The happiness approach, for example, does not consider, like the capability theorists, the effect of *adaptive preferences* (Nussbaum, 2011). Martha Nussbaum (2011) explains that people can seem happy, and even say that they are happy, in less than ideal circumstances. People can believe they should be content to live a life deprived of some basic opportunities simply because they have adapted to living a life without any of these opportunities. A learner from a low socio-economic group studying STEM only because of ample bursary opportunities (see 3.2.2.4), might report that she is happy. Such a learner might have adapted well to studying STEM, but in essence is deprived of opportunities such as having enough time for leisure (spending time on recreational activities) and being able to rely on imagination and senses (thinking about what might be, not only about what is) (see 4.5 and Appendix E). People whose focus are on the achievement of certain opportunities at the cost of others, might harm their own wellbeing. For the sake of an individual's personal wellbeing, the CA proposes that opportunities, whether available or achieved, should be assessed as part of an opportunity set (see 3.2.2.4).

3.2.2.7 Other elements of value

Ultimately, each person lives an embodied life and as such should have available opportunities towards achievement that should not be harmed by research projects and the possible (un)ethical behaviour of researchers (Robeyns, 2017). Regardless of the focus area of the researcher, measures should be put in place to protect the interest of each person who either participates in the research, or who might accept the results of the research. I have adhered to the ethical rules and regulations of both the FSDoE and the UFS while carrying out this research project. I am also bound to a personal motto of "first, do no harm".

Researchers should, specific to the context of a capability application, include elements, other than the core elements already mentioned, include elements that follow on to core elements. These elements include individual accounts of: humans as agents; human diversity; structural constraints; the element that lies central; empirical analysis; and the purpose of the application (Robeyns, 2017). The element of humans as agents (to act and bring about change as mentioned by Robeyns in 2017) is however not considered in this study from a CA perspective, as the assumption is made that agency was adequately considered during the discussion of SCT (see 3.2.1.2). Also, human diversity is taken into account and discussed in the chapters to follow by the discussion of biographical factors that were collected regarding this sample of Grade 10 learners. Human diversity is taken into account by including gender and ethnicity. Structural constraints are taken into account by including an account of whether both parents are still alive or not, the type of school that the learner attend and the school quintile. Structural constraints are also respected in the sense that people's opportunity sets are shaped by the social norms, institutions, policies and laws they encounter. These social norms, institutions, policies and laws influence the post-compulsory uptake of PS in the form of groups of factors: systemic, school or external, as discussed in Chapter 2. In South Africa, a Grade 10 learner's opportunity set is shaped not only by the South African School's Act No. 84 of 1996 (Republic of South Africa, 2011), but also by various policy documents as mentioned in Chapter 1 (see 1.3.1). Given that the implementation of these policy documents is dependent on, for example, the management of a specific school or institution where the learner is enrolled (see 2.2.2.2), it becomes clear that opportunity sets of learners are shaped independently of each another.

Robeyns (2017) also explains that researchers should be explicit about whether available opportunities, achieved opportunities, or both elements lie central to their application. In this study, I have mentioned that BROE and the option to choose PS at post-compulsory level are assessed as opportunities available to the Grade 10 learner. The achieved opportunity of interest is assessed as the Grade 10 learner realising choice satisfaction regarding post-compulsory uptake of PS. This implies that both available opportunities and achieved opportunities lie central to my study.

Given that data is gathered numerically in this study, another element that carries value is that of methods for empirical analysis, which I describe in Chapter 4 as *the framework for integrated methodologies (FraIM)* (Plowright, 2011). By elucidating *FraIM* and my use thereof (see 4.2), some of my meta-theoretical commitments are made explicit in the sense that the choices I make to carry out the processes in *FraIM* are pragmatic. The pragmatic paradigm links well with the CA in the sense that people leading a life of quality that contributes to their wellbeing, are choosing to live life according to the values that they find useful and that work for them. The highlighting of my meta-theoretical commitments aligns with Robeyns's observation (2017) that researchers should be explicit regarding their own meta-theoretical commitments for the purpose of sharing work done from a capability perspective with researchers from other paradigms.

In the following chapter, Chapter 4, I explain how *FraIM* is employed to illuminate the role of PSE as a unique concept and an individual factor encapsulated into SCT, as a possible personal conversion factor in what I propose as a narrow capabilities application. PSE is unique in that it involves agency and therefore affects whether a person can seize opportunities and transform them into performance. The role played by PSE in increasing STEM participation and persistence is receiving increasing attention from diverse research perspectives. In this regard, researchers from an educational perspective agree with vocational psychology perspectives that it would be useful to explore links between efficacy, performance, engagement and participation (Bennett, et al., 2013; Brown & Lent, 2016). With my conceptualisation of *perceived power* I investigate my expectation that PSE can transform available opportunities, for example BROE and the option to choose PS at post-compulsory level, into an achieved opportunity of choice satisfaction towards post-compulsory PS, in the

presence of certain elements of human diversity and structural constraints. That explains then the purpose of this capability application, namely to possibly conceptualise PSE as a personal conversion factor towards choice satisfaction in the context of post-compulsory PS.

3.3 CONCEPTUAL FRAMEWORK: PERCEIVED POWER

With Figure 3-2, I present my general conceptualisation of how SCT and the CA complement each other. For instance, from the perspective of the CA, available opportunities might be described as the part numbered 2 in the spatial pattern, while achieved opportunities (employing the available opportunities) might be described as the part numbered 1. The part numbered 3 in this pattern might be seen as 'other elements of value or of ultimate value'. This implies that, in a specific example with regards to the TRD concept, I expect thought (2) to represent available opportunities to be transformed by PSE into performance (1) as an achieved opportunity, while the experience of the social environment (3) is claimed, in this example, to represent 'other elements of value or ultimate value'. In order to empirically determine whether my general conceptualisation can be useful, it will require investigations regarding possible relationships between the variables of interest in a specific context, and the mapping out of unidirectional patterns between 1, 2 and 3, with the corresponding alternate explanations regarding agency and PSE, and the processes involved in the TRD concept, as given in each context.

The interactions between processes and concepts in Figure 3-2 and Figure 3-3 are represented by lines as 'links' on the diagrams. In other words, in the specific example used in Figure 3-2 and Figure 3-3:

- the light blue line represents expected theoretical interactions between **thought**, **experience** and **performance** within the TRD concept
- the green 'link' represents expected theoretical interactions between **thought** as an available opportunity and **experience** representing 'other elements of value'
- the dark blue 'link' represents expected theoretical interactions between personal conversion factors (in Figure 3-2) and **thought** as an available opportunity
- the red 'link' represents expected theoretical interactions between agency and TRD, at the point of **performance** (in this example a proxy for achieved opportunities)

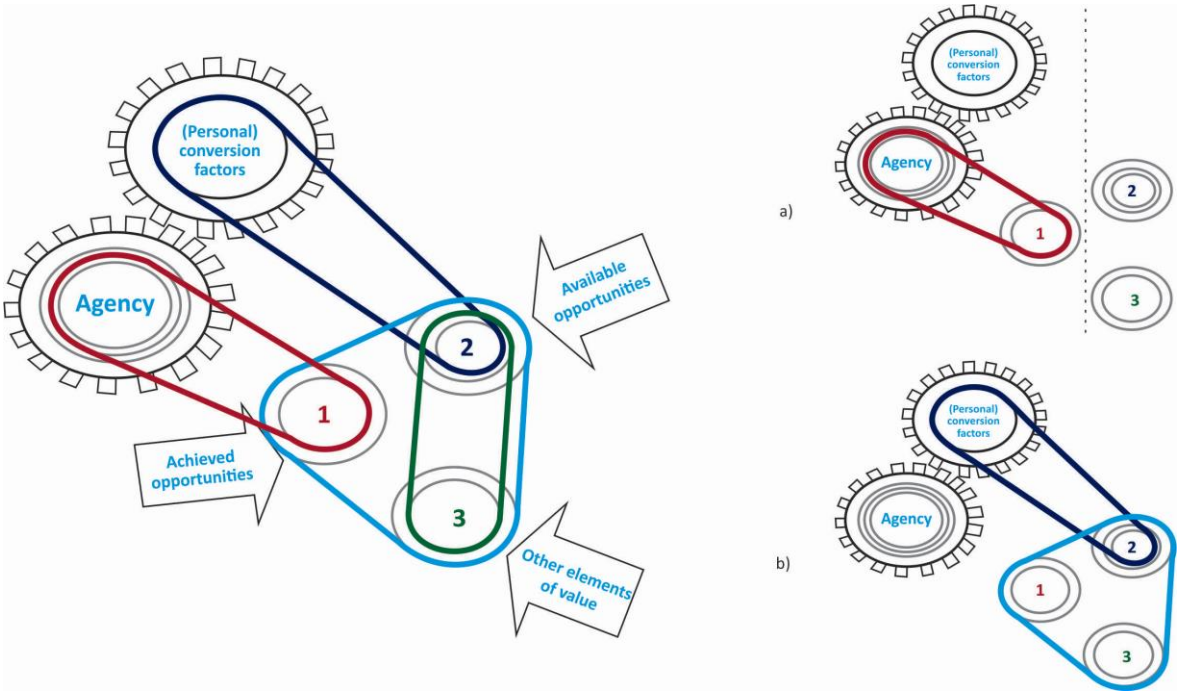

Figure 3-2: Representation of the CA and SCT complementing one another: development of *perceived power* (drawing: Francisco Fourie, 2018)

In this study I propose a framework with PSE as a personal conversion factor to transform the available opportunity of post-compulsory subject choice, in the context of PS, into an achieved opportunity of post-compulsory choice satisfaction. Biographical factors (as a proxy of human diversities and structural constraints) (see 2.3.3.7) were taken into account, and BROE were considered as achieved opportunities. In this context, I coined the term *perceived power* of the learner to represent the concept of PSE acting as a personal conversion factor.

Figure 3-3 presents *perceived power* as a conceptual framework drawn from SCT and the CA as a narrow capability application (Robeyns, 2017). This application, *perceived power*, presents expected interactions between PSE, proposed available opportunities (presented as BROE and subject choice) and an achieved opportunity (post-compulsory choice satisfaction) in the presence of 'other elements' such as human diversity (gender & ethnicity) and structural constraints (either parents still alive or not, type of school, school quintile) (compare with Figure 3-1).

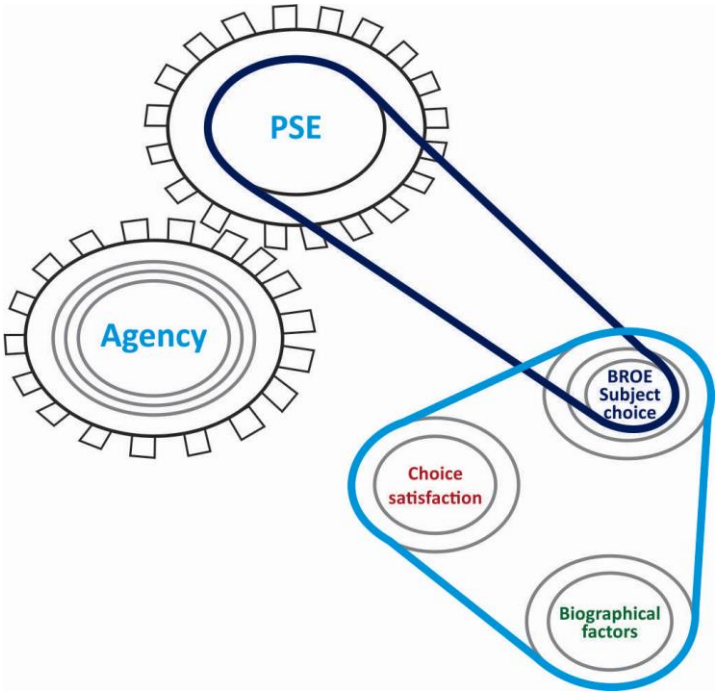

Figure 3-3: Diagrammatic representation of perceived power in context of PS choice satisfaction (drawing: Francisco Fourie, 2018)

To investigate the expectation of PSE presented as personal conversion factor to realise choice satisfaction regarding post-compulsory PS as presented in this conceptual framework, Figure 3-2 maps out three possible patterns. First the possibility for PSE to, by itself, contribute sufficiently towards learners' increased choice satisfaction regarding post-compulsory PS. This pattern is represented in Figure 3-2; a) with a disconnection of the link between PSE and BROE, and a simultaneous disconnection of the link between BROE, subject choice and choice satisfaction. Should this be the only pattern to emerge, it is highly unlikely for PSE to be conceptualised as a conversion factor. With a direct link between PSE and an achieved opportunity, per definition I can claim that available opportunities were not transferred into the achieved opportunity by way of PSE's influence. In the next chapter, this expectation is investigated empirically when the influence of 'other elements of value' (assessed as biographical factors), and available opportunities (BROE and subject choice), are negated in terms of the following research question: How is perceived self-efficacy related to Grade 10 learners' choice satisfaction regarding post-compulsory uptake of Physical Sciences?

Second, an expectation is presented for BROE that represents educational opportunities available to a certain extent, and also taking into account some other elements of value

(biographical factors), to possibly influence learners' experience towards the opportunity of achieving post-compulsory choice satisfaction regarding PS. This pattern is represented in Figure 3-2; b) by a connection of the link between PSE, BROE and subject choice, as well as a simultaneous connection of the link between BROE and subject choice, and choice satisfaction. Given this situation, the TRD-link (see Figure 3-1), inclusive of elements of human diversity and some structural constraints, will have to be connected as well. This theoretical claim is investigated as an empirical expectation in the next chapter, by answering the research question: How is perceived self-efficacy related to post-compulsory choice satisfaction of grade 10 learners, regarding Physical Sciences, when taking into account some biographical factors and basic realised opportunities in education? I expect that a higher level of BROE achieved (available opportunities) and in general less structural constraints (as assessed by some biographical factors) could possibly result in a learner achieving more valued choice satisfaction regarding post-compulsory PS.

Third, to answer the main research question: To what extent can perceived self-efficacy be seen as a personal conversion factor towards post-compulsory choice satisfaction regarding Physical Sciences? A possible answer lies in comparing the first and second scenarios, and the likelihood that PSE can affect a learner's choice satisfaction irrespective of the level of BROE achieved, or the involvement of 'other elements of value' like human diversity or structural constraints (assessed as biographical factors) as represented in Figure 3-3. In an empirical context, as I explain in the next chapter, the expectation investigated is for PSE to affect a learner's choice satisfaction, in the context of post-compulsory PS, independently from available opportunities such as BROE and 'other elements', like those assessed as biographical factors.

Perceived power is investigated empirically in the chapters to follow. Consequently its possible usefulness in situations similar to Grade 10 learners' post-compulsory choice satisfaction in the context of PS is discussed.

3.4 CONCLUSION

To conclude, from a theoretical perspective it is conceivable that PSE, taken from SCT, is expected to be seen as a conversion factor, as defined in the CA. Theorists from a SCT perspective explains the bidirectional influences of peoples' thought, experience and action

on one another by means of the TRD concept. The mutual relationships between these processes can be described in a simplistic, unidirectional manner, either spatially or sequentially. Three levels of agency, namely individual, proxy and collective, act as driving forces behind TRD, and in turn, the effect of agency is influenced by PSE. PSE, or the accuracy of self-judgements in specific contexts, is a concept claimed by researchers to influence the level of action people take. The context of this study is that of learners who are satisfied with their post-compulsory choice regarding PS, where learners judge themselves on whether they would be able to adapt to the novelty of a new subject and deal with associated setbacks on post-compulsory level. The claim I am making is that if learners can judge themselves accurately to adapt to the novelty of a new subject and deal with associated setbacks at post-compulsory level, it would expectedly increase their opportunity towards being satisfied with the choice they made in Grade 9. They would therefore be expected to achieve choice satisfaction in Grade 10. This suggests that PSE can possibly be employed as a personal conversion factor affecting the extent of post-compulsory choice satisfaction regarding PS. In the event of PSE being employed as a personal conversion factor, my expectation is that PSE should, to a certain extent, enable learners towards achievement of choice satisfaction, even if other educational opportunities such as physical health and learning disposition are available at low levels, and elements like 'structural constraints' hamper development. *Perceived power* is thus employed as a narrow capability application to investigate the usefulness of PSE as personal conversion factor towards transforming BROE and subject choice, into post-compulsory choice satisfaction in the presence of some 'other elements of value' (biographical factors). In the next chapter, Chapter 4, I discuss the appropriate methodology towards an empirical investigation regarding the usefulness of perceived power to be employed in the context of this study. This is done, as David Plowright suggests (2011), by asking appropriate research questions that encapsulate the variables represented in *perceived power*.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 INTRODUCTION

The problem addressed in this study is the decline in post-compulsory uptake of PS. My interest lies in the fact that the concept of PSE and its influence on post-compulsory uptake of PS is under-researched. In this context I describe the average PSE of the group of Grade 10 learners forming part of this sample in terms of gender, ethnicity, having both parents still alive or not, as well as school quintile and the type of school that they attend; and I do the same for average choice satisfaction. I then investigate the claim that PSE can be seen as a factor through which opportunities can be converted into achievement, in other words becoming a personal conversion factor from a CA perspective (see 3.2.2.2)

To best form a holistic understanding of Grade 10 learners' choice satisfaction regarding Physical Science (PS), *FraIM*, *the framework for integrated methodologies,* was employed (Plowright, 2011). *FraIM* constitutes a framework regarding certain basic processes to carry out when undertaking a research project. *FraIM* gives researchers the means to acknowledge flexible problem-solving by addressing one or more research questions. Researchers employing *FraIM* perceive knowledge as a way in which an individual or social group perceives the real world (Plowright, 2011). By making use of *FraIM,* I have adopted a pragmatic, justifiable way of investigating the problem posed in this study, by asking specific research questions encapsulating the variables presented in *perceived power*, the conceptual framework I developed in Chapter 3 (see 3.3). By answering these specific research questions, I could make pragmatic decisions without compromising the validity of the study. The research question to be answered is: To what extent can perceived self-efficacy be seen as a personal conversion factor towards post-compulsory choice satisfaction regarding Physical Sciences? In this regard, the following sub questions need to be answered:

- How is perceived self-efficacy related to Grade 10 learners' choice satisfaction regarding the post-compulsory uptake of Physical Sciences?

- How is perceived self-efficacy related to post-compulsory choice satisfaction of Grade 10 learners, regarding Physical Sciences, when taking into account some biographical factors and basic realised opportunities in education?

In order to answer these questions, data on PSE of Grade 10 learners were collected by means of a validated questionnaire, some biographical detail was collected, and basic realised opportunities in education (BROE) were measured numerically by means of a questionnaire developed by Ruswa (2015). Numerical studies from a CA perspective are rare (Kuklys, 2005), and Ruswa contributed to this field with his questionnaire which was the first to numerically measure educational opportunities on the Higher Education level. In applying Ruswa's questionnaire, this study contributes to numerical knowledge building from a CA perspective. This study is also novel in the sense that it contributes towards theory-building within the CA in claiming that PSE could probably be seen as a personal conversion factor (Robeyns, 2017). To measure PSE numerically, an internationally validated self-efficacy questionnaire was chosen, with the aim of assessing the ability to respond to novel situations and to deal with any associated setbacks (Love, et al., 2012). This focus is appropriate since taking up any new learning area in Grade 10 qualifies as a novel situation and can have some associated setbacks. Choice satisfaction of Grade 10 learners regarding post-compulsory uptake of PS was measured on a scale which I developed (see 4.5).

4.2 FIT OF RESEARCH DESIGN TO RESEARCH QUESTIONS

Due to its pragmatic nature, *FraIM* allowed me to make appropriate choices regarding the design of this project which were fit to answer the posed research questions (Plowright, 2011). Each stage of the research process, as indicated in Figure 4-1, was followed to ensure that appropriate choices regarding the research design were made so that justifiable answers to the research questions could be given. Figure 4-1 is a simplification of the first stages of the *FraIM*, claimed by Plowright (2011) to be incorporated in any research processes. In Chapter 5 some of the stages to follow are discussed, including evidence of analysis and the explanation of claims (Plowright, 2011). Chapter 6 comprises the last stage Plowright (2011) thinks should be addressed in order to produce warrantable research, namely answering the research questions by summarising all findings, discussing limitations and making recommendations regarding future research.

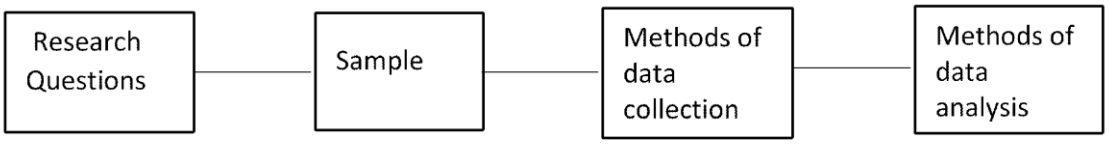

Figure 4-1: Basic structure of the FraIM as adapted from Plowright (2011)

FraIM lends itself to solve problems of an interdisciplinary nature (Plowright, 2011). In the conceptual framework of this study (3.3), concepts are borrowed from SCT and the CA to try and contribute to a solution in addressing the problem of a decline in post-compulsory uptake in PS.

With this study my aim is to investigate expected relationships between PSE and choice satisfaction of Grade 10 learners. A very specific sample of learners was required to allow for description of average PSE and choice satisfaction of Grade 10 learners at post-compulsory level, as well as answering the research questions. This implied purposive sampling of Grade 10 learners and pragmatic data collection, with the aim of describing PSE and choice satisfaction, as well as answering the research questions regarding three variables, namely BROE, PSE and choice satisfaction of Grade 10 learners regarding post-compulsory PS.

Similarly, appropriate methods of data analysis were chosen to justifiably infer relationships between the mentioned variables and to answer the research questions as comprehensively and justly as possible, within particular constraints in terms of time, money and resources. Linear regression analysis was chosen as the main method of data analysis, since such an analysis can give an indication of whether PSE can predict choice satisfaction independently from other factors like BROE and biographical factors. When a regression analysis is done, descriptive statistics are useful in giving an overview of the dataset in terms of the variables, and inferential statistics are useful in giving an idea regarding the usefulness of the specific regression model towards explaining the relationship between the predictor variable(s) and the outcome variable (La Puente, 2012).

4.3 LIMITATIONS & ETHICS

Researchers making use of the *FraIM* ask research questions (see Figure 4-1) in such a way that numerical as well as narrative data can be integrated in an optimal way to answer their questions justly (Plowright, 2011). One of the limitations of this project is that I only made use of numerical data to answer the research questions. The collection of numerical data was relatively quick and easy. For me, it was also simpler to focus on numerical (quantitative) methods only, without having to master narrative approaches (qualitative methods) as well. Incorporating a narrative approach could have contributed to improving our understanding of learners' choice regarding post-compulsory PS, but I took a decision to omit this on the grounds of time constraints, on the one hand, and ethical issues on the other. The Free State Department of Education (FSDoE) is very clear about the fact that research should not interfere with teaching time. I obtained permission from the FSDoE to conduct research in the Lejweleputswa District from 22 June 2017 to 30 September 2017 (see Appendix A). In this regard arrangements were made with the principal of each of the schools involved on strategies to suit their respective schools best (see Appendix B). If I wanted to have interviews with learners, or wanted to collect narratives, it would only have been possible after the initial analysis of the numerical data, which was in October 2017. The consequence of this is that the FSDoE would only have granted me an extension to this project during the second term of 2018, since they do not allow research during the first and fourth terms of each year. This eliminated the possibility of narratives. Plowright's pragmatic design allowed me to take this decision, as answering the above-mentioned research questions justly by making use of numerical data alone, is possible. Time and ethical constraints would have prevented me from utilising a traditional "mixed methods" approach. From the outset, being guided by the *FraIM* meant that the option of either omitting or including narratives was left open – if ethical clearance had been obtained earlier, allowing for sufficient data-collection time within the ethical window, narratives could have been included to deepen our understanding regarding PSE as a factor influencing Grade 10 learners' post-compulsory subject choice.

The use of Likert scales can be seen as a limitation, since different people interpret the levels within a Likert scale differently. Also, the analysis assumes the distance between successive items in the Likert scale to be equal, which is not the case (Plowright, 2011). Another

limitation of surveys is the fact that not much in-depth data can be collected. Despite this, surveys are used to identify issues that can be studied in more depth and on a larger scale during further research (Unterhalter & Walker, 2007).

Ruswa's questionnaire is a novel application within the context of high school education, and therefore the construct(s) assessed should be justified. Justification of a construct, or determination of construct validity, can be done statistically by means of factor analysis (Thompson & Daniel, 1996). This was not done here, since this was not the focus of the study. However, an exploratory factor analysis was done, with the aim of addressing the limitations regarding the novelty of this questionnaire. The exploratory factor analysis reported the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity. The KMO statistic indicates the strength of relationships between variables (items) and factors (constructs). A value close to one indicates a strong relationship, and a value less than 0.5 implies a weak relationship between the construct and items forming part of the construct (Field, 2009). Bartlett's Test gives an indication whether correlations are significantly different from zero, or if variables correlate in a way significantly different from an identity matrix (Field, 2009). For a questionnaire to be useful, Bartlett's Test needs to be significant. Claims made in terms of the KMO-statistic and Bartlett's Test, for Ruswa's questionnaire as well as for the other two questionnaires, PSE and choice satisfaction, are discussed with issues of validity and reliability (4.6).

Regarding Ruswa's questionnaire, a pilot study addressing two issues was done. Firstly I needed to ensure the relevance of Ruswa's opportunities identified in Higher Education for high school learners, and secondly that the learners could understand the language. The pilot took place in February 2017 when ten Grade 11 learners at a high school volunteered to answer the questionnaires. The ten learners were of different cultural backgrounds, and they gave valuable input towards constructing a more user-friendly questionnaire before the final survey to be completed by Grade 10 learners in July/August 2017, was compiled. A limitation of this questionnaire is the reliance on self-reported data using a long questionnaire in a language which is not the learners' home language, without the researcher present to explain unclear question. The input of the volunteers contributed to reducing this limitation.

Regarding the surveys, parental consent was negotiated with the parents of each school individually, and learner assent was also given by each learner who completed a survey (see Appendix C). Prior to data collection, ethical clearance was obtained from the Ethics Committee of the University of the Free State's Faculty of Education (see Appendix D) with ethical clearance number UFS-HSD2017/0134. I made it clear at all times that participation was voluntary, and that refusal to take part would not result in any harm.

Using linear regression can be a limitation if one does not have sufficient knowledge about at least some assumptions that need to be satisfied by the data (La Puente, 2012). Prof Robert Schall from the Statistical Consultation Unit at the UFS was involved with my project from March 2017. Before compiling the final survey, I discussed the questionnaires and variables with him and in consultation, we refined the survey before it was printed and taken to individual schools later that year.

4.4 SAMPLE

Since the specific research questions required participants to be learners at post-compulsory level, with access to PS, participants were chosen by means of non-probability purposive sampling (Plowright, 2011). Grade 10 learners were sampled from seven schools offering PS. This sample of Grade 10 learners was chosen purposively, but also conveniently given that the seven schools are, for logistical reasons, in the Lejweleputswa district, Free State, where I live. Regarding sample size, Field (2009) and Plowright (2011) concurs regarding a sample size in the order of 541 Grade 10 learners being large enough that generalising of findings is possible.

A summary of the number of respondents per school, together with information on the types of school, is presented in Table 4-1.

Table 4-1: Number of respondents by school

	Quintile	Description of School			Number of Surveys:			
					Handed out	Returned	Unspoilt	Learners taking PS
A	5	Public	Technical High school	Parallel medium	184	92	78	35
B	3	Public	Technical High school	English medium	333	115	95	92
C	5	Public	Secondary school	Parallel medium	180	154	142	57
D	3	Public	Secondary school	English medium	316	253	185	81
E	5	Public	Secondary school	Afrikaans medium	188	25	25	17
F	3	Public	Secondary school	Parallel medium	250	0	0	0
G		Independent	Combined / Independent	English medium	29	23	16	8
				TOTALS:	1480	662	541	290

In an attempt to ensure similar educational opportunities for all learners, the South African government has demarcated each public school as belonging to one of five quintiles, on the basis of socio-economic status (Department of Education, 2003). In general, quintile 1 to 3 schools are attended by the poorest learners and quintile 4 and 5 by the least poor learners (Spaull, 2012). In order to represent poor as well as more affluent learners equally in this study, three quintile 5 and three quintile 3 schools as well as an independent school formed part of the sample. Independent schools differ from public schools mainly in the sense that they do not receive government funding (Republic of South Africa, 2011). As mentioned before, purposive sampling was used so that only schools which gave all learners the option of taking PS as a subject at post-compulsory level were included in the sample. Of the learners in this sample, 52% were from quintile 3 schools and 48% from quintile 5 schools.

Technical high schools differ from ordinary secondary schools in the sense that they specialise in an organised field of learning, namely Manufacturing, Engineering & Technology (Department of Basic Education, 2013). In South Africa, technical subjects are regarded as important, since by taking these subjects, learners are trained in scarce skills towards

becoming artisans, which is a priority in South Africa at the moment (Department of Basic Education, 2015). Until 2017 all learners at post-compulsory level in technical high schools took PS as one of their subjects. Technical Sciences has been implemented since 2017, so learners now have a choice between PS and Technical Sciences (Department of Basic Education, 2015). In this sample, 32% of learners were from technical high schools and 68 % from secondary schools.

Of the 541 learners making up this sample, 48% were female and 52% male. Regarding ethnicity the composition was as follows: 78% Black, 14.5% White, 6% Coloured and 1.5% Indian. The language of teaching and learning for 55% of the learners in this sample was English, 40.5% of the learners in this sample attended parallel medium schools and 4.5% attended an Afrikaans medium school.

It can be seen from Table 4-1 that participation in completing the surveys was in general above 50%, except for the parallel medium quintile 3 school with 0% participation and the Afrikaans medium quintile 5 school with 13% participation. The percentage of spoilt surveys remained below 10% with the exception of the quintile 3 public school, where language could have been a barrier towards learners answering the surveys, and the Independent school, where some surveys could not be used since those learners did not submit parental consent in writing.

Interesting to note is that regarding gender in the sample, the overall percentage females who took PS at post-compulsory level was 56%, and the overall percentage males who took PS at post-compulsory level was also 56%. Regarding ethnicity, some differences in post-compulsory uptake of PS exist in this sample. Learners taking PS per ethnic group are 60% Black, 28% Coloured, 89% Indian and 46% White.

4.5 DATA COLLECTION

Surveys (see Appendix E) consisting of three questionnaires based on the variables of interest were distributed to each school on the basis of individual arrangements made with the principal of each school. Grade 10 learners completed the questionnaires at their respective

schools using pen and paper. This took place at a time negotiated by each school's principal, in order not to disrupt learning and teaching time. Surveys included:

- some biographical information
- **PART A:** Whether PS forms part of their subject choice: YES or NO
- **PART B:** A scale on choice satisfaction (developed by me).

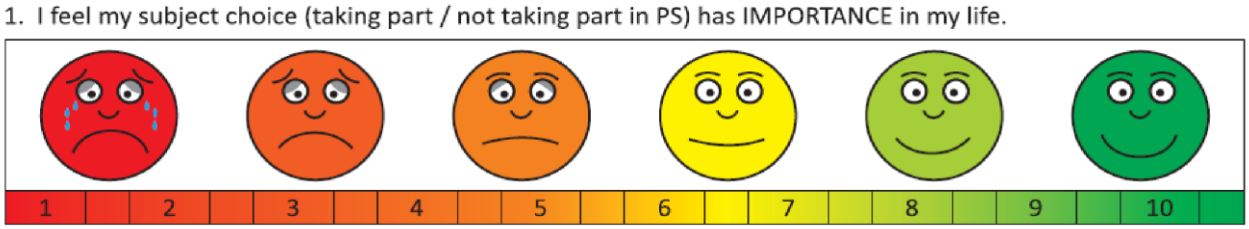

Figure 4-2: Example of item in choice satisfaction scale

I asked learners forming part of the sample to rate their feeling towards taking part in PS as being important in their lives (see Figure 4-2), being useful to them, being to their advantage, and being to their benefit (PLG, 2009). As I have mentioned, for the purposes of this project, my expectation is an assessment of choice satisfaction of Grade 10 learners in the context of PS. I used emoticons for learners to rate their feeling towards taking part in PS, since, in my experience as a teacher, most teenagers relate to emoticons to express their feelings on social media.

- **PART C:** PSE-scale (Love, et al., 2012)

Typical items included in this scale are assessing strength in belief to respond to novel situations and to deal with any associated setbacks (see 3.2.1.3), for example: *I can always manage to solve difficult problems if I try hard enough.*

These items were assessed on a 4-point Likert scale where the learner could opt for: not at all true, hardly true, moderately true or exactly true.

- **PART D:** Basic Realised Opportunities in Education (Ruswa, 2015)

As mentioned previously, nine Basic Realised Opportunities in Education (BROE) were identified by Ruswa (see Table 3-1), and are included in his questionnaire. Each realised

opportunity is operationalised by a certain number of questions on a 5-point Likert scale of *disagree strongly, disagree somewhat, undecided, agree somewhat* and *agree strongly.*

Typical examples of items are:

- D1: **education resilience**: *I was able to deal with the transition from Grade 9 to Grade 10*
- D2: **learning disposition**: *Grade 8 and 9 equipped me with the skills needed for Grade 10*
- D3: **physical health***: I feel that enough healthy meals are included in my day to prevent me from losing concentration in class*
- D4: **physical integrity**: *I can afford the school uniform*
- D5: **senses, imagination & thought**: *When I am learning, I think about what might be, not only about what is*
- D6: **emotions**: *I am not fearful or anxious in learning situations*
- D7: **practical reasoning**: *My ideas/skills are supporting me to achieve my goals*
- D8: **affiliation**: *I find it easy to relate to my peers in the classroom*
- D9: **leisure**: *I have recently been spending time on recreational activities*

Data was collected amongst Grade 10 learners sampled at the respective schools (see 4.4) and then analysed as described in 4.7. The evidence of data analysis and consequent claims are given in Chapter 5, while answers to the research questions are presented in Chapter 6.

4.6 VALIDITY & RELIABILITY

Precautions regarding validity and reliability of a study, as well as instruments used in a study, contribute towards meaningful, appropriate and useful outcomes from the data (Straub, 1989). In this regard, the internal consistency or the stability of measurement between learners in this sample was determined by means of Cronbach's alpha (Field, 2009). Values of alpha close to one would imply good internal consistency of measurement, thus reliable results (Field, 2009). Reliable results does not however imply meaningful results. In this

regard, Straub (1989) explains that the instruments of measurement should characterise the constructs explained by the theory (content validity). Content validity is usually determined by a panel of experts (Thompson & Daniel, 1996) on the construct(s) in question. For PSE and BROE, content validity has been determined prior to this study (Love, et al., 2012; Ruswa, 2015). Contributing to the validity of this study is the justification of concepts by means of exploratory factor analysis (Thompson & Daniel, 1996). SPSS was used to calculate the KMO-statistic and Bartlett's Test (see 4.3) for the survey as a whole, and also for each construct separately. In his book "Discovering Statistics using SPSS" (2009) Field describes that the KMO can be calculated for items from a questionnaire comprised of an individual construct, and items from more than one questionnaire comprised of variable constructs. The calculated KMO statistic for all items in this survey was 0.850, which indicates overall good correlation between items of the survey. For this survey, Bartlett's Test was significant ($P<0.001$), which means that the overall correlations are significantly different from zero. In the following paragraphs the construct validity and internal reliability of each of the three questionnaires, PSE, BROE and Choice satisfaction, are discussed.

4.6.1 PERCEIVED SELF-EFFICACY

The questionnaire chosen to measure PSE was published by Love, Dea Moore and Hensing (2012) as an internationally validated Swedish translation of the "General self-efficacy scale". I chose this questionnaire because the publishers claim that it assesses "strength of an individual's belief in their own ability to respond to novel situations, as well as their ability to deal with any associated setbacks" (p. 1249). As discussed in Chapters 2 (see 2.2.2.4) and 3 (see 3.2.1.3 and 3.3), self-efficacy should not be seen as "general", but as context-specific. Love, Dea Moore and Hensing interpreted self-efficacy as "general", although their questionnaire is employed in this study within a specific context (Bandura, 2007) and not as "general". The context of this study is that of PSE contributing towards learners' choice satisfaction regarding post-compulsory PS. PS at post-compulsory level is seen as a novel situation, since it is the first time learners experience PS as a school subject (Department of Basic Education, 2013). PS as a school subject can have some associated setbacks that learners should adapt to. For example, in addition to mastering content, learners have to master complex practical as well as cognitive skills (Free State Department of Education,

2018). Based on this I suggest that, for the purposes and within the context of this study, this questionnaire is a valid measurement of PSE.

Internal consistency for the PSE questionnaire was determined by means of Cronbach's α. Love, Dea Moore and Hensing (2012) determined their questionnaire to reliably measure "strength of individual's belief in their own ability to respond to novel situations, as well as their ability to deal with any associated setbacks" (p. 1249). Since α= 0.91, they concluded that their questionnaire measures a unidimensional construct which they termed "general self-efficacy" (Love, et al., 2012). I explained that, for the purposes of this study, this construct will be referred to as PSE. Cronbach's α in this study was found to be 0.75, which corresponds with Love, et al.'s cross-cultural validation (2012) using samples from 25 countries, indicating alphas between 0.75 and 0.91. The calculated α = 0.75 suggests that within this sample, the PSE questionnaire consistently measured what it claims to measure.

The KMO statistic for data collected using the PSE questionnaire was calculated with SPSS and equals 0.839. Bartlett's Test for the data is significant ($P<0.001$). It is thus justified to accept that, among the learners sampled in this study, this questionnaire measures what it claims to be measuring.

4.6.2 BASIC REALISED OPPORTUNITIES IN EDUCATION

Relevant opportunities for student wellbeing in Higher Education were identified and quantified by Ruswa (2015). For this study, ten Grade 11 learners from a high school volunteered in 2017 to take part in a pilot of Ruswa's questionnaire. This was to ensure that opportunities seen as appropriate to students could also be seen as appropriate to high school learners. Some of the items had to be changed, for example "I was able to deal with the transition from school to University" was changed to "I was able to deal with the transition from Grade 9 to Grade 10". Another example of a changed question is "The university has facilities to cater for all my medical needs" which was changed to "When I am not feeling well I get the support I need from school or my parents/guardians". I expected that opportunities relevant to the wellbeing of students regarding their education should be similar to those relevant to the wellbeing of learners regarding their education. Ruswa's study was novel in identifying and quantifying these opportunities, and my study is novel in its application of

Ruswa's questionnaire in the high school context. To reduce a possible limitation regarding the novelty of this questionnaire, I performed some exploratory factor analysis to confirm construct validation, and in the process justify my decision to make use of this questionnaire (Thompson & Daniel, 1996). Exploratory factor analysis was done by calculation of the KMO-statistic and Bartlett's Test with SPSS.

Internal reliability was determined by calculating Cronbach's α. Overall internal reliability and construct validity appears convincing, since the overall KMO-statistic for BROE is 0.851 with Bartlett's Test as significant (P<0.001), and Cronbach's α for BROE = 0.872. Internal consistency in this study was also determined for each individual's basic realised opportunity in educational (BROE), and the corresponding Cronbach's α's are reported in Table 2. Each individual construct forming part of BROE was correspondingly validated separately by calculating individual KMO-statistics, as reported in Table 4-2.

Table 4-2: Cronbach's *α* and KMO tests for educational opportunities

Basic realised educational opportunity (BROE)	**Cronbach's alpha**	**KMO-statistic**
Educational resilience	0.657	0.749
Learning disposition	0.633	0.754
Physical health	0.432	0.563
Physical integrity	0.575	0.587
Senses, Imagination & Thought	0.646	0.688
Emotions	0.725	0.786
Practical reasoning	0.647	0.725
Affiliation	0.606	0.677
Leisure	0.750	0.791

"Physical health" and "Physical integrity" had relatively low α's and KMO-statistics, however in general, both α and KMO for other BROE constructs were high. All α's as well as KMO-statistics (see 4.3) are above the minimum level for a construct to be accepted as reliable and valid, except the α for "Physical health" which equals 0.432; that is < 0.50 (Field, 2009). This implies that the BROE questionnaire, although a justified assessment of this construct, does not consistently assess the "Physical health" of Grade 10 learners forming part of this sample. This inconsistency of measurement can be explained by investigating the items forming part of this construct, for example: *I feel that enough healthy meals are included in my day to prevent me from losing concentration in class*. Learners in this sample did not answer items concerning "Physical health" consistently, and in the South African context that raises concern.

Bartlett's Test was significant (P<0.001) on all constructs. On the basis of the evidence provided above, my decision to present results based on BROE for this sample of Grade 10 learners is justified.

4.6.3 CHOICE SATISFACTION

I developed a questionnaire to assess learner choice satisfaction (see 4.3). Internal consistency for this questionnaire was determined by calculating Cronbach's α which equals 0.93, indicating good internal consistency. SPSS was used to calculate the KMO-statistic and Bartlett's Test to determine construct validity. In this regard KMO equals 0.853 and Bartlett's Test was significant (P<0.0001). This implies that it is justified for me to present results regarding the post-compulsory PS choice of Grade 10 learners forming part of this sample, as obtained from the Choice satisfaction questionnaire.

Straub (1989) explains that the justification of instruments is an important step towards the justification of a study, and that statistically significant outcomes of an investigation cannot be justified without justification of the instruments. Given that the internal consistency and construct validity of the three questionnaires forming part of the surveys in this study has been established, the data can now be analysed.

4.7 DATA ANALYSIS

Data from these surveys were analysed statistically by Prof Robert Schall from the Statistical Consultation Unit at the UFS. SAS was used to do correlation and regression analysis (SAS Institute Inc, 2016). In order for me to better understand the statistical analysis of data, I completed three workshops on statistical analysis presented by the Post-Graduate School of the UFS. These workshops were presented specifically on how to use SPSS to analyse data. The UFS makes SPSS available to its postgraduate students free of charge. The result of me completing the workshops on SPSS was that this program was downloaded on my personal computer by the IT department of the UFS, and I could replicate Prof Schall's analysis, to better my own understanding. The results of my replicated analysis are similar to the initial analysis, with small differences that can be accounted for by differences between SAS and SPSS. Given that I copied the initial analysis to better my own understanding, Prof Schall's analysis is reported.

Representing the constructs under investigation, descriptive statistics for the PSE and choice satisfaction domains were calculated. In order to gain perspective regarding the background of the data set, the average PSE and average choice satisfaction regarding the diverse sample of Grade 10 learners are described in Chapter 5 (see 5.2). The following domain averages were calculated from the Likert scale responses:

- Choice satisfaction (domain B)
- PSE (domain C)
- BROE (domains D1 to D9)

In order to explore the study objectives, the following simple and multiple regression analyses were performed:

1. Regression of choice satisfaction (domain B average) against PSE (domain C average)
2. Regression of choice satisfaction (domain B average) against PSE (domain C average) and BROE (domains D1 to D9 averages)

In the multiple regression models, the demographic variables were fitted as potential confounders. Results of the simple and multiple regression models are reported and

interpreted in Chapter 5, and in order to obtain clarity regarding the usefulness of these regression models, F-statistics and t-values are reported (La Puente, 2012).

4.8 CONCLUSION

In this chapter *FraIM* as model was discussed in planning and executing my research project. By employing *FraIM*, I acknowledged that some basic processes should be carried out in order to answer the research questions which I developed from the literature review and conceptual framework. In this chapter the focus was on validity and reliability, as well as limitations and ethics regarding sampling, data collection and data analysis.

Sampling was done purposively and conveniently, since in answering the specific research questions, Grade 10 learners that have access to PS were chosen to participate in the research. Given that sampling was also constrained by the logistical aspects of data collection, Grade 10 learners who participated and had access to PS, were from high schools in the area where I live, Lejweleputswa District, Free State. Data was collected by means of pen and paper surveys on three variables of interest, and SAS was used to perform correlation and regression analysis.

Although *FraIM* does not restrict researchers regarding numerical or narrative analysis, this analysis is purely numerical. As explained, I took a decision to omit narrative analysis on the basis of time and ethical constraints. In the following chapter, Chapter 5, the processes of Evidence and Claims as forming part of *FraIM* are discussed.

CHAPTER 5: EVIDENCE OF ANALYSIS AND EXPLANATION OF CLAIMS

5.1 INTRODUCTION

In this chapter, the analysis of data gathered on PSE, BROE, learners' choice satisfaction regarding post-compulsory PS and some biographical factors (human diversities and structural constraints) are discussed. In order to better understand the relationship between PSE and choice satisfaction, some characteristics of the diverse sample of Grade 10 learners are described in the context of each one of the variables PSE and choice satisfaction, individually. I use variables from *perceived power*, the conceptual framework developed in Chapter 3 (see 3.3) to investigate the expectation that the relationship between PSE and Grade 10 learners' choice satisfaction is independent of BROE and some human diversities and structural constraints. I can therefore claim the probability for PSE to be seen as a personal conversion factor in transforming the opportunity of subject choice towards post-compulsory PS, into achieving satisfaction with choice regarding post-compulsory PS, in the presence of BROE, some human diversities and structural constraints. In the context of the CA biographical factors, ethnicity and gender can for example be claimed as an account of human diversity, while school quintile and type of school can be claimed as an account of structural constraints (Robeyns, 2017)(see 3.2.2.7). In the process of answering the research question "To what extent can perceived self-efficacy be seen as a personal conversion factor towards post-compulsory choice satisfaction regarding Physical Sciences?" the following sub questions need to be answered:

- How is PSE related to Grade 10 learners' choice satisfaction regarding the post-compulsory uptake of Physical Sciences?
- How is PSE related to the post-compulsory choice satisfaction of Grade 10 learners, regarding Physical Sciences, when taking into account some biographical factors and basic realised opportunities in education?

One way to address these sub questions is by performing simple and multiple regression analysis with PSE as predictor variable and choice satisfaction as outcome variable. During

multiple regression biographical factors were fitted as potential confounders and BROE was adjusted for. Some inferential statistics, namely F-statistics and t-values, are reported in order to examine the usefulness of the multiple regression models. The aim of this analysis was to investigate whether PSE can predict choice satisfaction independently of biographical factors and BROE. Thus, in the context of PS, I can theoretically claim that PSE does act as personal conversion factor to transform the available opportunity of subject choice, in the presence of BROE and 'other elements of value' (biographical factors) into satisfaction with choice. I have named this claimed personal conversion factor *perceived power* (see 3.3). In this chapter I am submitting my theoretical claims to scrutiny by investigating some empirical expectations regarding the usefulness of *perceived power* as a possible personal conversion factor towards transferring available opportunities into achieved opportunities.

5.2 PERCEIVED SELF-EFFICACY AND CHOICE SATISFACTION IN CONTEXT

In this study I investigate whether PSE predicts choice satisfaction as outcome. The sample of Grade 10 learners is biographically diverse regarding some opportunities, for example, gender, ethnicity, having both of their parents still alive or not, as well as the type of school that they attend. Table 5-1 presents descriptive statistics for PSE and choice satisfaction by the biographical factors of the sample. A summary by means of descriptive statistics, is useful in terms of portraying the raw data in a more comprehensible manner.

Table 5-1: Perceived Self-efficacy and Choice satisfaction: Descriptive statistics by biographical factors

		N	***PSE***		***Choice satisfaction***	
			Mean	***SD***	***Mean***	***SD***
Subject choice	Not taking PS	237	1.98	0.47	7.08	2.52
	Taking PS	307	2.08	0.48	7.51	1.99
Gender	Female	261	2.05	0.49	7.44	2.27

	Male	280	2.03	0.47	7.22	2.22
Ethnicity	Black	423	2.08	0.47	7.25	2.29
	Coloured	32	1.86	0.52	7.26	2.35
	Indian	8	2.20	0.40	7.94	1.80
	White	78	1.87	0.45	7.67	2.01
Both parents still alive	No	156	2.11	0.47	7.06	2.42
	Yes	385	2.01	0.48	7.43	2.17
School quintile	5	280	2.09	0.50	7.14	2.44
	3	261	1.98	0.45	7.53	2.01
School: Code, Quintile, Technical / Public	A, 5, Technical	78	2.08	0.48	7.50	2.05
	B, 3, Technical	95	2.04	0.51	7.76	2.01
	C, 5, Public	142	1.98	0.43	7.54	2.01
	D, 3, Public	185	2.12	0.49	6.81	2.57
	E, 5, Public	25	1.94	0.43	7.72	1.59
	G, 5, Private	16	1.95	0.35	7.23	2.48

The data from Table 5-1 shows that learners who take PS at post-compulsory level have, on average, a slightly better developed level of PSE than those learners who do not take PS. Those learners are, on average, also slightly more satisfied with their choice than learners who do not take PS. Although averages between female and male learners seem similar, female learners do appear to have developed, on average, slightly higher levels of PSE than male learners, and they seem a bit more satisfied with their post-compulsory subject choice than male learners. Regarding ethnicity, it seems that the average PSEs of Coloured and White learners are slightly lower than that for Black and Indian learners. In this regard, Indian

learners seem to be slightly more satisfied with their subject choice, whether this was taking PS or not. Although learners whose parents are both still alive seem to have developed, on average, a slightly lower PSE as opposed to those who have lost one or both parents, learners whose parents are both still alive are, on average, slightly more satisfied with their post-compulsory subject choice. This contradiction might be attributed to more parental support regarding post-compulsory choice towards learners with both parents still alive, although narratives collected on this matter can help us understand it better, one should keep in mind that descriptive statistics only give estimations based on averages, and that inferential statistics (see 5.3) are needed if information regarding statistical significance is required (Field, 2009).

Data from Table 5-1 gives the impression that learners from quintile 3 schools have, on average, a slightly lower PSE than learners from quintile 5 schools. This is contradicted by the average level of PSE developed by learners in each specific type of school. On average, learners of School B, which form part of the quintile 3 selection, seem to have developed the highest PSE. Learners of School A, which forms part of the quintile 5 selection, have developed the second highest average PSE. Interesting to note is that learners from those two schools (School B and School A) also seem to be on average more happy with their post-compulsory subject choice than, for example, learners from School D (quintile 3) and School G (quintile 5). On the basis of these descriptive statistics, various explanations for these differences can be claimed. One is the fact that both School B and School A are technical high schools, so they are specialised to some extent. It can be expected that learners attending these schools know themselves better and have developed higher PSE towards post-compulsory satisfaction of their subject choice. Descriptive statistics are only an estimation of average PSE and choice satisfaction on the basis of multiple variables, and, in order to move beyond estimations, information about inferential statistics is needed (Field, 2009). Inferential statistics can give us information regarding the statistical significance of relationships, for example whether PSE could predict choice satisfaction independently from BROE and biographical factors, and whether the data could be used to possibly predict similar situations (Field, 2009; La Puente, 2012). In the context of this investigation, it was conceivable to perform regression analysis as a powerful tool and model in answering the research questions. The need was to determine whether PSE can predict choice satisfaction

independently from biographical factors and BROE, and in this was be conceptualised as a personal conversion factor, which suggested multiple regression analysis as an effective tool.

5.3 RESULTS

The claim that learner choice satisfaction is predicted by PSE was investigated by performing a simple linear regression with PSE as predictor variable and choice satisfaction as outcome variable (see Figure 3-2; a)). The claim to follow, that the relationship between PSE and Grade 10 learners' choice satisfaction is independent of BROE and biographical information, was investigated by performing multiple regression analyses. This was done by firstly fitting biographical factors as potential confounders (see Figure 3-2; b)) and secondly, adjusting for biographical information and BROE (see Figure 3-3). Prof Robert Schall from the Statistical Consultation Unit at the UFS used SAS to do these regression analyses. Prof Schall performed the multiple regression analysis procedure as outlined by La Puente (2012), and included some statistical criteria for checking the practicality of this multiple regression model in explaining the data. La Puente explains that statisticians, when using SAS, see it as part of the process to calculate the global F-test, to give an indication of the overall significance of a regression model. F-statistics and t-statistics are also calculated when taking a decision about whether a specific multiple regression would be useful in explaining a certain set of data (La Puente, 2012). Higher F-statistics ($F > 0$) imply that the regression coefficients are not close to zero and that it is justified to claim that the regression model explains some of the variations in the data. Larger t-statistics imply that it is less likely for the actual value of a parameter to be zero. I use these statistics, mainly the global F-test, some F-statistics and t-statistics (La Puente, 2012), to examine how useful the multiple regression models are in explaining whether PSE can predict Grade 10 learners' choice satisfaction.

5.3.1 RELATIONSHIP BETWEEN PERCEIVED SELF-EFFICACY AND CHOICE SATISFACTION

Figure 5-1 shows the simple linear regression (compare with Figure 3-2; a)) of choice satisfaction (outcome or dependent variable) against PSE (predictor or independent variable). The regression slope for PSE is 1.305 ($P<0.0001$), which is highly significant, although the regression R^2 is only 0.077 (7.7% of variance in satisfaction with choice explained by PSE).

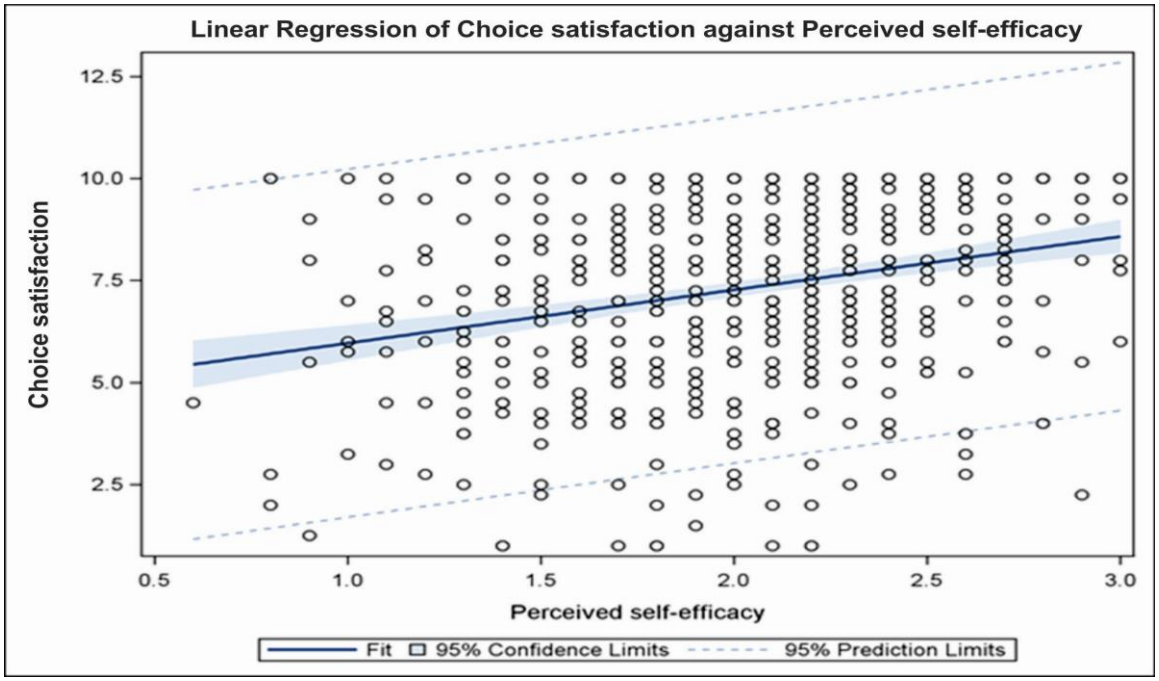

Figure 5-1: Simple linear regression of PSE predicting Choice satisfaction

When performing multiple regression, adjusting for biographical factors (see Figure 3-2; b)) like age, gender, language, ethnicity, school type and school quintile, 13.06% of the variance in satisfaction with choice is explained by the multiple regression model (R^2 = 0.1306). The regression slope for PSE in the multiple regression model is 1.348 (P<0.0001), which again is highly significant. The slope of 1.348 indicates that an increase of 1 unit in average PSE implies an increase of 1.38 in average satisfaction score.

Table 5-2: Simple and multiple linear regressions of Choice satisfaction against PSE

	Choice satisfaction / PSE	Choice satisfaction / PSE *Adjusting for Biographical factors*	Choice satisfaction / PSE *Adjusting for Biographical factors and BROE*
R^2	0.077359	0.130571	0.193815
Slope	1.30544662	1.34781470	0.78339123

From Table 5-2 it is evident that the regression slope for PSE remained essentially unchanged from the simple linear regression (slope of 1.305) to the multiple regression (slope of 1.348)

when adjusting for biographical factors (compare Figure 3-2 a) with b)). These findings suggest firstly that PSE is an independent predictor of satisfaction with choice, since PSE remains a significant predictor of satisfaction with choice even after adjustment for biographical factors in the multiple regression model. Secondly, the biographical factors do not seem to mediate the effect of PSE, since the regression slopes for PSE respectively in the simple and multiple regression models when adjusting for biographical factors only, are similar. Next, the multiple regression when adjusting for biographical factors and BROE are discussed.

5.3.2 BASIC REALISED OPPORTUNITIES IN EDUCATION MEDIATING THE RELATIONSHIP BETWEEN PERCEIVED SELF-EFFICACY AND CHOICE SATISFACTION

Multiple regression was performed with choice satisfaction as the outcome variable, and PSE as the predictor variable, fitting biographical factors as potential confounders and adjusting for BROE (see 3.3 & Figure 3-3). Table 5-2 indicates that this multiple regression model explains 19.38% of the variance in satisfaction with choice ($R^2 = 0.1938$).

Under this multiple regression model, the regression slope for PSE is 0.783 (P=0.0007), which is somewhat lower than the slope of 1.305 from the simple regression, and lower than the slope of 1.348 from the multiple regression that did not adjust for BROE. Again, firstly these findings suggest that PSE is an independent predictor of choice satisfaction, since PSE remains a significant predictor of choice satisfaction even after adjustment for both demographic variables and BROE in the multiple regression model. Secondly, BROE seem to attenuate the effect of PSE somewhat, since the regression slope for PSE, when BROE are taken into account, decreases to 0.78 from about 1.3 when BROE are not taken into account.

Although it seems that PSE does remain an independent predictor of choice satisfaction under the above-mentioned multiple regression, when adjusting for both biographical factors and BROE, as mentioned above, the effect of PSE on choice satisfaction is somewhat attenuated by BROE. Some inferential statistics, presented in Table 5-3, were employed to investigate the value of this model in answering the research questions (La Puente, 2012).

Table 5-3: Multiple linear regression models of Choice satisfaction against Perceived Self-efficacy

Demographic categories (Other elements)	***DF***	***F Value***	***Pr > F***
Subject choice	*1*	*2.29*	*0.1310*
Gender	*1*	*0.54*	*0.4611*
Ethnicity	*3*	*6.55*	*0.0002*
Both parents still alive or not	*1*	*0.28*	*0.5947*
School quintile	*1*	*10.99*	*0.0010*
Specific type of school	*1*	*1.91*	*0.1674*
BROE			
Educational resilience	*1*	*14.93*	*0.0001*
Learning disposition	*1*	*14.96*	*0.0001*
Physical health	*1*	*2.54*	*0.1115*
Physical integrity	*1*	*12.13*	*0.0005*
Senses, imagination & thought	*1*	*1.20*	*0.2745*
Emotions	*1*	*2.46*	*0.1176*
Practical reasoning	*1*	*21.58*	*<.0001*
Affiliation	*1*	*0.79*	*0.3747*
Leisure	*1*	*1.00*	*0.3171*

The results presented in Table 5-3 suggest that ethnicity and school quintile were statistically significant confounders in the multiple regression model, since the F-statistics for both those factors are high as well as significant. Furthermore from Table 5-3, Educational resilience, Learning disposition, Practical reasoning and Physical integrity were significant BROE after adjustment for demographic variables. The relationship between Physical integrity and choice satisfaction, though, shows a significant negative relationship (t=-3,45; P=0,0005), implying that learners with low PSE are more satisfied regarding post-compulsory subject choice while they are experiencing high Physical integrity. Physical integrity measures whether a learner

feels safe on the school grounds in terms of physical and sexual harassment. From this data it seems as if learners with low PSEs have high measures of Physical integrity, and learners with high PSEs have low measures of Physical integrity. To understand this outcome better, one will have to do a follow-up investigation. A claim, in the South African context, could be that learners with lower PSE group together in the form of gangs, with the purpose of protecting each other (Wegner, Behardien, Loubser, Ryklief & Smith, 2016).

In the context of this specific investigation, it is sufficient to say that enough information is available to answer the research questions, since the global F-value, which tests the significance of the independent variables as a group for predicting the response variable (La Puente, 2012), for the multiple regression model adjusting for both biographical factors and BROE was $F = 5.66$ ($P<0.0001$). This indicates that the independent variables as a group, in this multiple regression model, with PSE as predictor and adjusted for biographical factors and BROE, significantly predicted choice satisfaction as outcome variable. One should also keep in mind that the unchanged slope establishes PSE as an independent predictor of choice satisfaction.

5.4 EXPLANATION OF CLAIMS

In this study I claim the probability for PSE to be seen as a personal conversion factor in transforming BROE and the option to take PS at post-compulsory level, into satisfaction with choice regarding post-compulsory PS. Since these results indicate that PSE predicts Grade 10 learners' choice satisfaction independently of some of BROE (senses, imagination & thought, emotions, affiliation and leisure), and some of the elements concerned with human diversity and structural constraints (gender, both parents alive or not, specific type of school), this study has demonstrated how PSE can be employed as a personal conversion factor.

5.4.1 RELATIONSHIP BETWEEN PSE AND THE TYPE OF CHOICE LEARNERS MADE

From the simple regression it is clear that a small percentage of satisfaction with choice can be attributed to PSE ($R^2 = 0.077$; $P < .0001$). Significant about the results, though, is the unchanged slope of the two regressions, indicating the fact that PSE acts as an independent predictor of choice, regardless of elements such as human diversity and structural constraints

(biographical factors). These findings concur with extensive research and consistent findings in the body of knowledge from SCT (Bandura, 2012) that self-efficacy is a unidimensional construct that can have an influence on the course of people's lives. Being a unidimensional construct does not imply that it is the only factor influencing people's lives, but PSE contributes to a multiplicity of factors forming part of the complexity of people's lives (Bandura, 2012).

Another observation is the fact that the slope of this simple regression is positive, indicating that learners with higher PSE tend to feel more satisfied about the choice they made regarding post-compulsory PS. Consistent findings throughout extensive research done in SCT report that an increase in people's beliefs in their competencies fosters self-regulation and enhances motivation (Bandura, 2012), which increases their ability to respond to novel situations, as well as their ability to deal with any associated setbacks.

5.4.2 EDUCATIONAL OPPORTUNITIES RESOLVING THE RELATIONSHIP BETWEEN PSE AND THE TYPE OF CHOICE LEARNERS MADE

During multiple regression when adjusting for BROE, an increase in PSE is still responsible for an increase in satisfaction with choice (slope = 0.78). The relationship between PSE and choice, though, is attenuated by BROE, since BROE takes on some aspects of the role of PSE, but not all of it. By investigating some inferential statistics it could be seen that, for example, Physical health and Emotions, show no significant relationship with PSE (see Table 5-3), while others, like Educational resilience and Learning disposition do show significant relationships with PSE. Importantly though, PSE is still an independent predictor unlikely to be affected by statistically unrelated factors in the account of human diversity, including gender; both parents alive or not, physical health, senses, imagination and thought, emotions. It is also unlikely to be affected by structural constraints such as type of school, affiliation and leisure. The slope remains positive, indicating that learners with higher PSE tend to feel more satisfied about their choice regarding post-compulsory PS. In other words, the results of this study concurs with the body of evidence from SCT stating that higher levels of self-efficacy foster implementation of a decision and pursuing it even in the face of difficulty (Bandura, et al., 2001).

Bandura explains, from the perspective of SCT, that higher PSE fosters ability (2012), which corresponds with Robeyns' definition from the CA, of what a conversion factor is (2017). A conversion factor transforms available opportunities into realised opportunities (Robeyns, 2017). In the context of this study, PSE fosters the ability of learners to judge themselves accurately so that they can use the opportunity concerning subject choice, to choose in such a way that they achieve satisfaction with their choice, specifically regarding post-compulsory PS.

Further investigation regarding structural constraints, here assessed as biographical factors such as ethnicity and school quintile, might be justified, since the F-statistics for both these factors are high as well as significant ($P<0.001$). This implies that these two factors contribute to a better fit of the multiple regression model when adjusting for biographical factors. It is not unlikely that ethnicity and school quintile might be related to one or more of the four processes involved in the strengthening of PSE (see 3.2.1.3). These four processes have been named by Bandura as social persuasion, vicarious experience, mastery of experience, and physiological states (1995). Similarly, further investigation regarding some of the factors of BROE, for example Educational resilience, Learning disposition, Practical reasoning and Physical integrity, might be justified. On the one hand, Educational resilience, Learning disposition and Practical reasoning have high as well as significant F-statistics ($P<0.001$). For Physical integrity the F-statistic is high and significant ($P<0.001$) but as I have mentioned previously, the t-statistic has a high negative value, and in the South African context this might raise some concern.

5.5 CONCLUSION

In this chapter I have determined that learners with higher PSE tend to feel more satisfied with their choice regarding post-compulsory PS than learners with lower PSE. It also became evident that learners with higher PSE felt more satisfied about their subject choice, irrespective of, for example, their socio-cultural and socio-economic backgrounds (some elements regarding human diversity and structural constraints).

The level of a learners' achieved BROE did affect the extent to which PSE predicted choice satisfaction, but learners with higher PSE still experienced better choice satisfaction,

irrespective of their level of BROE. This implies that learners with higher PSE can judge themselves more accurately to choose subjects that can contribute to the quality of their lives (Sen, 1965). This is the case even if elements contributing to the account of human diversity (for example gender, physical health, emotions) and the account of structural constraints (for example type of school) differ. Further investigation of some factors, like ethnicity and school quintile, can be justified, although my suggestion regarding PSE as an independent predictor of choice satisfaction, and thus *perceived power*, remains useable. This can be stated in light of the relatively stable regression slope under all the analysed regression models.

CHAPTER 6: SUMMARY, LIMITATIONS AND IMPLICATIONS

6.1 INTRODUCTION

With this project I researched factors that might impact the local and global decline in post-compulsory uptake of PS (see 1.3.1). In the literature four groups of factors, namely systemic, school, external and internal factors (see 1.3.2), were identified to play a role in the uptake of PS. In the literature study that followed, PSE was suggested as an internal factor, but under-researched in this context (see 1.4.2). PSE is one of the three central concepts from SCT (see 3.2.1) and is seen as personal judgements in specific contexts to motivate agency in initiating the processes forming part of TRD (see 3.2.1.1). From another perspective, however, PSE can be seen as a factor that enhances the quality of people's lives by transforming available opportunities into achieved opportunities (see 3.2.2). Factors that have the power to transform available opportunities into achieved opportunities are, from a CA perspective, conceptualised as conversion factors (see 3.2.2.2). Given the theoretical possibility of PSE to be seen as a conversion factor, as part of the group of internal factors, it is therefore plausible for PSE to be seen as a personal conversion factor. From the perspective of the CA, I developed, in the context of PS, *perceived power* as a narrow capability application towards transforming Grade 10 learners' available opportunities into achieved opportunities (see 3.3). I then used the variables delineated in *perceived power* to ask questions regarding my claims. These questions were used as the basis for an analysis (see 4.7) and explanation of claims made (see 5.4). In that sense I have subjected the theoretical expectations of *perceived power* to empirical investigation. In this chapter, I summarise the theoretical expectations in terms of my related empirical findings, to make sense of it all, and to propose my insight towards answering the main research question, namely:

- To what extent can perceived self-efficacy be seen as a personal conversion factor towards post-compulsory choice satisfaction regarding Physical Sciences?

I also summarise empirical claims made in previous chapters, and summarise answers to the following sub questions:

- How is perceived self-efficacy related to Grade 10 learners' choice satisfaction regarding the post-compulsory uptake of Physical Sciences?
- How is perceived self-efficacy related to the post-compulsory choice satisfaction of Grade 10 learners, regarding Physical Sciences, when taking into account some biographical factors and basic realised opportunities in education?

In addition, I discuss the limitations and implications of my study. I discuss the limitations of the methodology in terms of data collection and data analysis, and I indicate how future studies could reduce these limitations. Limitations regarding *perceived power* are also discussed, as well as some implications regarding its usefulness towards future research projects in the context of PS. The possibility of *perceived power's* usefulness in educational contexts other than PS are is discussed. I offer some final reflections before concluding the work.

6.2 SUMMARY OF KNOWLEDGE CLAIMS

The knowledge claimed from this study is twofold. Firstly, knowledge is gained in terms of *perceived power* as a conceptual framework, which can be employed as a narrow capabilities application to transform Grade 10 learners' opportunity of subject choice in the context of PS into an achieved opportunity of choice satisfaction (see 3.3; 3.2.2). Secondly, knowledge is gained towards the usefulness of *perceived power* in the context of Grade 10 learners transforming their available opportunities (beings) of subject choice and BROE in the presence of some elements of human diversity and some elements of structural constraint, into choice satisfaction as an achieved opportunity (doing) (see 3.2.2.1 and 3.2.2.7). The usefulness of *perceived power* was investigated empirically by means of linear regression methods (see 5.3).

6.2.1 THEORETICAL CLAIMS

- From the perspective of SCT, once people with high PSE employ agency effectively and at an appropriate level (see 3.2.1.3), the TRD pattern can be represented spatially (see 3.2.1.1) with its origin from thought, for example, being **2. Thought 1. Performance 3. Experience** (see Figure 3-1). In other words, through the appropriate application of

agency, PSE transforms thought and performance into an experience of post-compulsory choice satisfaction regarding PS.

- From a capabilities perspective, conversion factors are perceived as factors that transform available opportunities into achieved opportunities. Since the achieved opportunity investigated in this study is post-compulsory choice satisfaction regarding PS (see 3.2.2.2), relevant conversion factors include any factors that bring about post-compulsory choice satisfaction in the context of PS. Personal conversion factors are factors internal to a person, similar to PSE, that can transform available opportunities (beings) into achieved opportunities (doings)(see 3.2.2.1).
- In the context of this study, the conversion factor claimed to transform an opportunity regarding subject choice into post-compulsory choice satisfaction regarding PS is PSE. In this context, some other available opportunities were expected to be the nine opportunities encapsulated in BROE (see Table 3.1). My assumption was, in other words, that these nine opportunities encapsulated in BROE are opportunities achieved (doings) by a learner, and as such would feature opportunities available (beings) to a learner which I assessed numerically. An average level of BROE could be assigned to each of these nine opportunities, for each learner in this sample (see 4.7).
- Proposed relationships between available opportunities, personal conversion factors, achieved opportunities as well as 'other elements of value' are represented by means of a spatial separation pattern in Chapter 3 (see 3.3; Figure 3-2). These relations can be separated spatially to represent an unidirectional relationship of PSE as personal conversion factor, transforming the opportunity to subject choice in the presence of BROE and 'other elements of value and ultimate value' (see 3.2.2.5 & 3.2.2.7) into choice satisfaction regarding PS, as an achieved opportunity. By comparing Figure 3-1 with Figure 3-2, my suggestion is that, from a SCT perspective, the following can be grouped together as they involve **thought** processes: educational resilience, learning disposition, senses, imagination and thought, emotions, and practical reasoning (see 3.2.1). I also claim that that Physical health and Physical integrity, which involve **experiential** processes, can be grouped together, and affiliation and leisure can be grouped together as **performance**, or part of the learners' quality of functioning (see 3.2.1.1). Other elements of value, like human diversity and structural constraints (see 3.2.2.7), were taken into account and measured by giving an account of gender, ethnicity, both parents alive or not, school

quintile and type of school (see 5.3.2; Table 5.3). From a SCT perspective, my claim is that these elements can be seen as part of the social environment of the learner. So, theoretically, when mapping out the TRD concept spatially and unidirectionally, the following pattern emerges: **3. Experience 2. Thought 1. Performance** (see Figure 3-1 & 3.2.1.4). My claim is therefore that in this specific pattern PSE transformed 'other elements of value', as the experience of the social environment, to influence thought, as the available opportunity, into performance as an achieved opportunity. Since I am claiming that Physical health and Physical integrity, as opportunities and not as other elements of value, also involve experiential processes, I argue that these opportunities will form part of another pattern.

- As indicated, I coined the term *perceived power* to represent a narrow capability application to employ PSE as a personal conversion factor in the context of PS education, where the opportunity of choosing a subject is transferred into choice satisfaction in the presence of some achieved BROE and elements of human diversity as well as structural constraints (see 3.3). In terms of *perceived power,* one possible way of representing the relationships between variables during this investigation, is in a simplistic, sequential manner (see 3.2.1.1). The first pattern in a sequence of two, relates to a pattern initiated by **thought**, where my theoretical expectation is that thought is the available opportunity. Other elements of value are represented by the **experience** of the social environment, and in this specific pattern, I expect **performance** to be the achieved opportunity (see 3.3). Theoretically, this unidirectional pattern is expected to present itself as **2. Thought 3. Experience 1. Performance**, which can be followed as a clockwise pattern of TRD in Figure 3-2 (see 3.2.1.1). My claim is therefore that, in this specific pattern, PSE transforms thought into an experience of the social environment, which results in the performance of a learner – here towards affiliation and leisure. For example, a learner might have positive thoughts about participating in the Eskom EXPO for young scientists, or an experience of doing a project could have been fulfilling and the learner even made new friends, and so she signs up at her school's Science Club. This claim is not substantiated, given that, in this investigation, no narratives have been collected.
- I then theoretically claim a second pattern, in a sequence of two, which also entails **thought** processes. I expect these thought processes to represent available opportunities (education resilience, learning disposition, senses, imagination and thought, emotions

and practical reasoning) which could possibly, in the presence of **performance** as other elements (subject choice, affiliation and leisure – which have been influenced previously), to have an influence on the **experience** of choice satisfaction as achieved opportunity. This second unidirectional pattern represented is: **2. Thought 1. Performance 3. Experience**. In this second pattern, the bidirectional effect is illustrated in Figure 3-2 as a counter-clockwise pattern in the diagram. I can explain this in terms of the previous example: (in the presence of) being a member of the school's Science Club, this learner's available opportunities of, for arguments' sake, senses, imagination and thought, as well as practical reasoning, can have an influence on choice satisfaction regarding PS as an achieved opportunity.

- One of the claims I make in the context of this study is that physical health (concentrating in class) and physical integrity (feeling safe) (see Table 3-1) could be seen as experiential processes. In the sense of these two to be seen as experiential processes, a possible explanation can be offered to the empirical relationships of these two variables being different to that of other variables in this study (see Table 5.3). These alternative empirical relationships should be represented by means of spatial patterns other than the patterns explaining the relationships in this study.

6.2.2 EMPIRICAL CLAIMS

Linear regression was employed to empirically investigate the above-mentioned theoretical claims. I firstly investigated the relationship between choice satisfaction as outcome variable, and PSE as predictor variable by means of a simple linear regression. Secondly, multiple regression was employed to better my understanding regarding the usefulness of perceived power as a capability application. In this regard two multiple regressions were done.

- What I found regarding the simple regression, was that learners with better developed PSE seemed to be more satisfied with their post-compulsory subject choice regarding PS (see 5.4.1). This finding establishes a positive relationship between choice satisfaction and PSE; however, the finding does not clarify whether PSE could possibly be seen as a (personal) conversion factor, since no relationship with available opportunities could be found (see 3.3).

- In this regard, two multiple regressions were done. The first was a multiple regression where biographic variables (human diversities and structural constraints) were fitted as potential confounders. The slope of the first multiple regression was similar to the slope from the simple regression (see 5.3.1; Table 5.2), indicating that PSE predicted choice satisfaction, independent of most biographic factors theorised to be 'other elements of value or ultimate value' (see 6.2.1).
- In the second multiple regression, both biographic variables and BROE were fitted as potential confounders (see 5.3.2). When the effect of PSE on choice satisfaction was also adjusted for BROE (in addition to the adjustment for biographic factors), some attenuation of the slope was observed, implying that BROE affected the extent to which PSE predicted choice satisfaction. Nonetheless, learners with higher PSE still experienced a higher level of choice satisfaction (see 5.4).
- Upon investigation of the inferential statistics in the multiple regression models (see 5.3.2; Table 5.3), the data revealed that some variables had statistically significant effects on choice satisfaction in the context of the models fitted, while other variables did not have statistically significant effects. In this study, statistically significant variables related to choice satisfaction are ethnicity, school quintile, educational resilience, learning disposition, practical reasoning and physical integrity.
- In terms of the proposed theory (see 6.2.1) of the variables that show statistical significant relationships, I argue that ethnicity can be perceived as an element of human diversity, and school quintile as an element of structural constraint. Also, in terms of the proposed theory, educational resilience, learning disposition, practical reasoning and physical integrity can arguably be perceived to represent either available opportunities or achieved opportunities – what they are will depend on the specific context of the TRD pattern investigated (see 6.2.1). Significant relationships in terms of *perceived power* for this sample of Grade 10 learners, are between what I claim to represent 'other elements of value' (ethnicity and school quintile), and available opportunities (educational resilience, learning disposition and practical reasoning). Learners with high PSE, forming part of this sample, experienced little physical integrity (see 5.3.2) which might be interpreted, in the South African context, as learners who are not part of gangs (or groups, for that matter) and are not gaining protection from the gang (Wegner, et al., 2016) or

group (social groups could e.g. provide protection against bullying). With physical integrity claimed to be an achieved opportunity (see 6.2.1), and part of a pattern of TRD other than the one represented here, this unknown pattern could be followed up and explored by researchers in a narrative manner.

Data from this study revealed that PSE remains an independent predictor (see 5.3.1; Table 5.2) of choice satisfaction in the presence of the following statistically significant predictor variables: ethnicity, school quintile, educational resilience, learning disposition and practical reasoning. In other words, PSE and to some extent other realised available opportunities in education (educational resilience, learning disposition and practical reasoning), in the presence of human diversity (represented as ethnicity) and some structural constraints (represented by school quintile), played a role in predicting choice satisfaction of Grade 10 learners in the context of PS. Within the empirical context of this study, I can neither refute nor claim PSE to be regarded as a personal conversion factor, since I cannot say with certainty that available opportunities were transferred into an achieved opportunity. A follow-up study could address this by possibly using SEM (structural equation modelling) as analysis tool.

6.3 LIMITATIONS

In retrospect, I have to acknowledge some limitations regarding this study. In terms of methodology, linear regression as an analysis tool is not quite so simple after all, and surveys are not (always) the easy way out. In terms of *perceived power*, practical significance vs statistical significance was an issue, novelty is not always something to be excited about, and the role of agency was not fully explored.

- Linear regression is a fairly simple and easy statistical model to apply and interpret, but in that sense it might be abused by researchers who might have appropriate mathematical, but not appropriate statistical knowledge. In this regard I have consulted with Prof Robert Schall from the Statistical Consultation Unit at the UFS to do the data analysis and guide me with some aspects of data interpretation. One aspect to keep in mind when using multiple regression as a model, is that the influence of predictor variables on the outcome variable is assumed to be linear. In other words, multiple regression can only model relationships in a simplistic, linear way. By making use of Sharp and Miller's mechanistic

approach (2018) (see 3.2 & 3.3), bidirectional influences could be represented in a simplistic, unidirectional way, either spatially (see 3.2.1.4 & 3.3) or sequentially (see 6.2.1).

- Surveys with pen and paper were used to collect data for this investigation. Accessibility could have been enhanced and cost could have been cut with the use of electronic surveys, so researchers who plan future numerical investigations should consider the use of these. The fact that surveys were used to collect numerical data meant that not much in-depth data could be collected. This method of data collection did however open up opportunities to identify issues for further research. For example, I do not know whether some of the learners with high PSE are experiencing low physical integrity due to the fact that they are not affiliated to a specific group or gang, which I have suggested as a possibility. Clarity on this issue can be gained by means of another project where narratives are collected. I also do not know why some learners, with a high level of PSE, experienced low choice satisfaction, and others with a low level of PSE, experienced high choice satisfaction. This can be seen from the simple regression performed with PSE as predictor and choice satisfaction as outcome variable (see Figure 6.1). These are assumptions that can be clarified by means of narratives in future projects.

Figure 6-1: Simple linear regression of PSE predicting Choice satisfaction – some outliers highlighted

- With R^2 as indication, the practical significance of *perceived power* is low. Given the second multiple regression (see Table 5.2), only 19.38% of variance in choice satisfaction can be explained by this model. This implies that, in contexts similar to the sample in this study (see 4.4), PSE and the statistically significant available opportunities (see 6.2.1), were responsible for about 19% of achieved choice satisfaction of Grade 10 learners in this sample, in the context of PS. These findings are consistent with the findings of researchers from a SCT perspective where the contribution of PSE to influence people's lives are typically in the range of 20% (Bandura, et al., 2001; Bandura, 2012). Bandura (2012) warns that researchers should keep the following in mind: PSE is not the only factor to influence people's lives, and PSE contributes to a multiplicity of factors forming part of the complexity of people's lives. Keeping in mind that PSE forms part of a whole, a contribution of 19% towards choice satisfaction, when PSE is claimed to be one of more concepts contributing towards a whole of 100%, can arguably affect a person's life meaningfully towards living a life of quality. PSE is therefore seen as contributing to one part. It is also seen as a conversion factor, transforming some available opportunities, constituting the opportunity set of a person, into achieved opportunities that can contribute to the quality of life of that person. In the context of intervention techniques to add quality to people's lives, the strengthening and development of PSE (see 3.2.1.3) should in other words not be considered as an only intervention technique, but should be considered as intervention in collaboration with other techniques towards the strengthening of educational resilience, learning disposition and practical reasoning.
- This project has some novelty regarding research methodology as well as instruments of measurement. The problem with novelty is that it is often accompanied by some uncertainty that can give rise to questions regarding the validity of the study as a whole. My claim, in terms of *FraIM*, is that the methodology is justified, and hopefully more students in the social sciences will discover the usefulness of David Plowrights' *FraIM* (see Chapter 4). Regarding the instruments used to measure BROE and choice satisfaction, some exploratory factor analysis were done (see 4.6) to ensure validity in the context of this study. Although proper factor analysis is preferable, the outcome of the exploratory factor analysis was acceptable on both accounts. These instruments might therefore be

useful in future studies within this context, as well as in studies within other STEM-education contexts.

- This investigation explored the role of PSE as a personal conversion factor towards transforming some available opportunities into post-compulsory choice satisfaction in the context of post-compulsory choice regarding PS, yet the role of agency was not explained clearly. Theoretically, from a SCT perspective, the relationship between PSE and agency is known, so, it might be useful to explore possible links between agency and the variables within *perceived power*. I used the expected relationships in *perceived power* (see 3.3) as research questions, and in this regard investigated the relationships between personal conversion factors, available opportunities, achieved opportunities and some 'other elements of value and ultimate value', while the role of agency was simply inferred. With recent research from a CA perspective within the context of STEM-education, Mathebula makes a claim in her book 'Engineering Education for Sustainable Development: A Capabilities Approach' (2018), that the exercising of agency is fundamental to 'public-good engineering education'. She therefore places an emphasis on the role of agency. Future investigations that make use of *perceived power* should address this limitation of not properly attending to agency by attending to the possible contribution of agency towards PSE as a personal conversion factor.

6.4 IMPLICATIONS

Regarding the notion that PSE can be employed as a personal conversion factor, my claim is that the possibility exists for perceived power to be employed in contexts other than PS education. Teachers and policy makers can possibly employ perceived power during an analysis of either available or achieved opportunities to determine possible contextual factors (resources) towards enhancing specific PSE and agency in the context of interest.

- My claim is that the concept of PSE as a personal conversion factor, thus *perceived power*, can be refined and employed regarding the possible relationships between variables of interest in specific contexts that researchers might want to investigate. Researchers should be able to, from a CA perspective, classify variables of interest as either available opportunities, 'other elements of value or ultimate value' or achieved opportunities. In this regard I claim that the mapping of unidirectional patterns between available

opportunities, 'other elements of value or ultimate value' and achieved opportunities, numbered as 1, 2 and 3 (with numbering purely descriptive – see Figure 3-2) is a possibility. Should researchers be willing to employ *perceived power* in this regard, I claim that corresponding explanations regarding agency and PSE are possible. This application of *perceived power* is in accordance with Robeyn's teachings (2017). Once it is known how a conversion factor can be employed, resources can be put in place so that the conversion factor can transform these resources into achieved opportunities.

- Teachers and policy makers can possibly, when analysing learner opportunities from a CA perspective, employ *perceived power* in order to draw sequential patterns representing the TRD concept. Within the context of specific 'other elements of value and ultimate value', it might be possible to describe the level of agency and PSE a learner would need to transform specific available opportunities into achieved opportunities. In this regard appropriate resources could be put into place. For example, regarding Mathebula's capabilities-inspired empirically informed framework for public-good engineering education (2018), the possibility is not excluded to refine and employ *perceived power* into describing the level of agency and PSE students need to, for example, be critical thinkers, be open minded, achieve self-knowledge and be able to self-regulate. Once the level of agency and PSE to be employed in achieving these opportunities can be described, appropriate resources can be put into place to achieve the mentioned appropriate opportunities.
- In this investigation, variables with statistically significant effects on choice satisfaction (apart from PSE) were ethnicity, school quintile, educational resilience, learning disposition, practical reasoning and physical integrity. Theoretically I have explained that my claim is, on a social environmental level, for ethnicity to represent an element of human diversity while school quintile can be seen as a structural constraint. As such both elements have a bearing on available opportunities on the level of thought, claimed to be educational resilience, learning disposition and practical reasoning (see 6.2.1). I have also explained that I see physical integrity as an available opportunity on the experiential level, which does not form part of the same pattern regarding choice satisfaction as the other variables.
- One implication can be that researchers should pay attention to the effects of intervention programmes on the level of thought. My argument is that individual agency was

employed towards achievement of the opportunity regarding choice satisfaction. In this regard, a suggestion can be made that resources be put in place towards the strengthening of individual agency (see 3.2.1.3).

- It also raises some concern that school quintiles, theoretically claimed to be a structural constraint, are excluded from the data to be statistically significant. In other words, real differences between schools from different quintiles exist. This is in accordance to what Spaull (2012) found regarding SA's bimodal schooling system – although from this data I could not as such confirm the bimodal character.
- Concern is raised regarding the relationship between physical integrity, PSE and choice satisfaction. In the SA context this relationship needs to be explored in more detail.

6.5 SOME REFLECTIONS

In the words of Leo Tolstoy[1]:

Art [the research process] is a microscope [tool] which the
artist [the researcher] fixes on the secrets
of his [her] soul, and shows to
people these secrets which
are common to all.

During this journey of three years, I have not only learnt a lot regarding research and the research process, but gained some valuable self-knowledge as well. It was a serendipitous telephone call from a friend (thank you Neil) in January 2016 that led me to finalising and formalising the proposal for this study. Being a PS teacher, I have been walking around with this question in my mind for a very long time. In retrospect, this question originated from my own experiences as a high school learner, as well as my observations regarding my peers. I can even claim that my observations regarding the availability of learner opportunities and the consequent influence that this has had on their lives date back to my pre-school years and interactions with our neighbours, as well as some of the people who worked with my father. Obviously, throughout my younger years, I did not have the formal language to describe these

[1] https://www.azquotes.com/quote/654055

observations, and in the 1970s children in our society were not allowed to ask too many questions.

Three years ago, with this serendipitous confluence of events, I could eventually begin to put my questions into words. My friend Neil made me aware of an opportunity offered by the UFS towards post-graduate studies. He is the one friend that always reminds me, that in essence I am an educator, with a passion for learners and the opportunities offered to learners. This opportunity offered by the UFS allowed me to explore my unanswered questions and develop my skills towards academic writing and carrying out the research process.

Honestly, this was, and still is, intimidating. There was a lot of frustration and crying involved. That first 'perfect draft' that ends up to be nothing but a few lines of incoherent, illogical thoughts on a piece of paper – that was heart breaking! In one of the first contact sessions one of the lecturers told us that it's called re-search, as you constantly go back and do things over. And I remember that I thought "yeah right, I am an experienced teacher, I am the examiner of some Olympiad question papers, and I've been through some tough stuff in life …" Here I am –still re-thinking, re-drawing, re-phrasing, re-reading. At least I have stopped re-calculating now. And I would not have been able to stop the recalculating and have peace of mind regarding the statistical outcomes if not for the fact that Prof Robert Schall was involved in my project. It was really reassuring to be able to discuss statistical issues and questions with somebody who really has expert knowledge. I would recommend that to anybody. Given that Prof Schall is so knowledgeable, I had to prepare well in order to ask him some meaningful questions, so I have learned a lot about statistics as well. In some instances I discussed Prof Schall's explanations with Anesu Ruswa, who encouraged me to master SPSS and copy the calculations in order for me to better my own understanding. In other instances I had to discuss Anesu as well as Prof's explanations with my friend Maud, who teaches Mathematics, so that she could explain the content on a level where I could understand it. Only then could I take on some further reading about the matter. Here, I also need to acknowledge my cousin Herman van Vuuren from UNISA. He is busy with a PhD in Research Psychology, and in that sense could explain some statistical concepts to me. He also recommended that I read Field (2009), who explains the statistics on a level where I find it easier to comprehend. Discussions

with Anesu, and the consequent workshops on SPSS I attended, bettered my own understanding immensely. In this regard, the post-graduate school played a major role. Workshops arranged by the post-graduate school propelled me into a better understanding of concepts that I had difficulty with.

The post-graduate school, specifically Tshepiso Molaba, offered efficient assistance regarding workshops I attended. Those workshops added real value to this thesis. It was during a writing workshop that Tshepiso picked up on my interest regarding the Capability Approach and she put me in contact with Dr Mikateko Höppener, who introduced me to the work of Anesu Ruswa. Anesu's work forms a pivotal part of my study. Also, through Anesu, I made contact with the Higher Education and Human Development research group at the UFS and attended some of their seminars. I sincerely hope that the value of these seminars reflect in my study. Furthermore, through this research group and Prof Melanie Walker, I was introduced to the work of Ingrid Robeyns. The work of Robeyns greatly shaped my thinking and contributes to a large portion of what you find in this thesis.

Dr Adré le Roux agreed to supervise my study as co-supervisor, since she does not work quantitatively. In this regard, I did not have a supervisor for this study until October 2016. I appreciate the fact that she did not restrict me to her specific research interest or methods, but rather developed my own interests as much as possible. This contributed much to my own development as a person. I am well aware that I probably caused her great frustration, yet she developed my skills towards research and academic writing and did not give up on me. She allowed me to make use of all possible facilities the UFS had to offer, for example the Statistical Consultation Unit and Prof Robert Schall, who contributed true value to this dissertation. Dr le Roux's, motivation and teaching came at crucial moments: initially when my research was still chaotic and did not have much direction, her inspirational way of teaching guided me towards gaining momentum; and towards the end, when I really wanted to quit, her guidance gave me the courage to continue.

Then, I was blessed with Dr Angela Stott as supervisor. Dr Stott acted as catalyst to familiarise me with the academic world and introduced me to some inspiring opportunities. The first of those was attending the Southern African Association for Research in Mathematics, Science and Technology Education conference (SAARMSTE) in Bloemfontein, January 2017. My life

after that can never be the same again. I was inspired to put my hand to article writing and was accepted to SAARMSTE 2018 in Botswana, with Prof Fred Lubben's writing clinic in conjunction as a bonus. I also participated in the International Conference on Physics Education (ICPE) at Krugersdorp, in October 2018. This conference was co-hosted by the South African Institute of Physics (SAIP) and the School of Physics, University of the Witwatersrand (WITS) jointly with the International Commission on Physics Education (C14) of the International Union of Pure and Applied Physics (IUPAP). These experiences shaped not only my academic writing, but also my development as an academic and as a person.

Dr Stott, in collaboration with UFS's post-graduate school, organised a writing retreat in November 2018, that I am convinced contributed towards me being able to submit this thesis. From Dr Stott I have learnt to never ever stop questioning yourself, the process, the outcomes from the data, nor your interpretation of what you have read – in short – never stop asking questions. From Dr Stott I have learnt time management, collaboration, and using tools such as heuristics, mind maps and PowerPoint presentations. Dr Stott truly empowered me to feel more confident forwards using the tools available in this process we call research – I feel strong enough to dive back in, and re-search towards meaningful solutions, specifically regarding learner/student opportunities.

A final thought: Given the opportunity, I would read more, listen to more people, have discussions with more people, attend more seminars, present at more conferences, and write more first drafts, since I have discovered that submitting this study is nothing more than challenging myself to a new beginning. It is not heart-breaking anymore that this study is imperfect and has shortcomings and pitfalls – that is probably why researchers go back and re-search. I am grateful towards each and every person I mentioned, who equipped me with a variety of skills towards finding meaningful solutions to problems, specifically regarding learner/student opportunities.

6.6 CONCLUSION

Although I did accomplish my initial goals, I am of the personal opinion that this investigation does not do the problem justice. What I have learnt is that one can have goals but as a researcher, one should allow the research process to guide you beyond your own limitations, even if it means to deviate from initial sub-goals and original plans. Research as a process to guide the researcher is probably the "take home message" from Plowright. In this regard I should I have trusted it beyond my own limitations and my suspicion is that I might have discovered useful information regarding the role of agency towards the realisation of choice satisfaction in the context of post-compulsory PS. But then again, as referred to by some researchers, the local and global problem of a decline in learner numbers in the STEM-field is a 'wicked problem', implying that the problem is multifaceted and not to be considered lightly. I do hope that from this initial development of *perceived power* I can continue into refining the concept, and that *perceived power* as a refined model can eventually contribute, from one perspective, to the alleviation of this problem, and to identifying some resources that can be put into place towards bettering the quality of learners' lives.

As a final thought, allow me to quote Max Planck: '*Science cannot solve the ultimate mystery of nature. And that is because, in the last analysis, we ourselves are a part of the mystery that we are trying to solve.'* And I have to play devil's advocate, and claim that [*knowledge*] cannot be created nor destroyed, but only transformed from one [*perspective*] to the other in order for [*a person (all people) to gain a life of quality*].

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APPENDICES

APPENDIX A: DBE - PERMISSION TO CONDUCT RESEARCH

education
Department of Education
FREE STATE PROVINCE

Enquiries: KK Motshumi
Ref: Notification of research: EP Venter
Tel. 051 404 9221 / 082 454 1519
Email: K. Motshumi@fseducation.gov.za

The Acting District Director
Lejweleputswa District

Dear Ms Zonke

NOTIFICATION TO CONDUCT RESEARCH PROJECT IN YOUR DISTRICT BY EP VENTER

1. The above mentioned candidate was granted permission to conduct research in your district as follows:

   Topic: General self-efficacy as capability towards appropriate choice regarding Grade 10 Physical Science.

   Schools involved: Welkom Gymnasium, HTS Welkom, Leseding, Lebogang, Goudveld, and Welkom Secondary Schools in Lejweleputswa District.

   Target Population: Grade 10 Learners.

   Period: From date of signature to 30 September 2017. Please note the department does not allow any research to be conducted during the fourth term (quarter) of the academic year nor during normal school hours.

2. **Research benefits:** This study focusses on forming a holistic understanding about learners' choice and factors preceding it. Consequently, learners making more appropriate choices in Grade 10 should have better quality of life, which should be reflected in an increased number of quality passes

3. The Strategic Planning, Policy and Research Directorate will make the necessary arrangements for the researcher to present the findings and recommendations to the relevant officials in your District.

Yours sincerely

DR JEM SEKOLANYANE
CHIEF FINANCIAL OFFICER

DATE: 22/06/2017

APPENDIX B: PRINCIPAL – PERMISSION TO CONDUCT RESEARCH

PERMISSION TO CONDUCT RESEARCH

With this the undersigned requires permission to conduct research at your school during August / September 2017. The researcher will negotiate suitable times, not to be at any inconvenience to the smooth running of your school. The aim of this project is a Masters dissertation in Psychology of Education at the School of Education Studies at the University of the Free State. The registered title of the project is: General self-efficacy as a capability towards appropriate choice regarding grade 10 physical sciences.

Some schools in the Lejweleputswa district have been selected to take part in this study on the basis of proximity, type of school and subject choice. Your school forms part of the selection and participation by your school will be much appreciated.

Reporting will be anonymous and all identities, that of the learner and of the school, will be considered as confidential at all times. Participation is voluntary and learners can withdraw at any time without being discriminated against. No learner will be harmed in any way by participating in this research.

The following would be required from your school:

- Permission from Grade 10 learners and their parents for the research to be conducted. Examples of permission letters are attached.
- Grade 10 learners to complete a questionnaire which should take them no more than 20 minutes (example attached) as per date(s) arranged in August / September 2017.
- The researcher would appreciate access to the SASAMS data base with regards to Grade 10 Physical Science / Mathematics and Mathematical Literacy marks for the first three terms of 2017.
- The researcher would appreciate access to the 2016 schedules in terms of the Natural Science marks of the same cohort of learners.

Also attached to this letter is a letter from Dr. A.E. Stott, confirming the researcher's registration at the UFS.

Your cooperation in this matter would be highly appreciated.

Sincerely

E.P.VENTER

Student no: 1988044861

APPENDIX C: PARENTAL CONSENT AND LEARNER ASSENT

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS UV

RESEARCH STUDY INFORMATION LEAFLET AND PARENTAL CONSENT FORM

DATE

To be negotiated with your school August / September 2017

TITLE OF THE RESEARCH PROJECT

General self-efficacy as capability towards appropriate choice regarding Grade 10 Physical Science - i.e. does the way(s) learners' think about the opportunities they have influence their subject choice (specifically then towards Physical Science in Grade 10)

RESEARCHER$ NAME(S) AND CONTACT NUMBER:

Name of student/researcher	Student number	Contact number
R.P. Venter	1988044861	082 566 8232
Name of student/researcher	*Student number*	Contact number
Name of student/researcher	*Student number*	*Contact number*

FACULTY AND DEPARTMENT:

Faculty of Education
School of Education Studies

STUDYLEADER(S) NAME AND CONTACT NUMBER:

Dr. A.R. Stott
0785080849

WHAT IS RESEARCH?

Research is something we do find new knowledge about the way things (and people) work. We use research projects or studies to help us find out more about children and teenagers and the things that affect their lives, their schools, their families and their health. Research also helps us to find better ways of helping, or treating children who are sick. We do this to try and make the world a better place!

WHAT IS THIS RESEARCH PROJECT ALL ABOUT?

This study focuses on Grade 10 learners' subject choice and the reasons behind their choice. For example: a) why the choice was made, b) what the real opportunities of the learners where in terms of subjects to choose from / physical health / emotions, c) what was the value attached to these opportunities when making the choices, d) does the choice contribute to well-being, e) who made the decision, f) what do they currently think about their choice.

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WHY HAVE YOUR CHILD BEEN INVITED TO TAKE PART IN THIS RESEARCH PROJECT?

A few schools from the Lejweleputswa district is included in this study, since the researcher is from Lejweleputswa. This makes it easier to collect the data. Different types of schools have been selected to include both English and Afrikaans as Language of Teaching and Learning. Schools should also have Physical Science as part of their subject choice in Grade 10. Your child does not have to be in Physical Science to take part in the study.

WHO IS DOING THE RESEARCH?

This project is done by Me E.P. Venter as a Masters in Psychology of Education at UFS. The well-being of learners is my passion. I am currently teaching Physical Science Grade 11 and 12 at Welkom-Gimnasium. I am also facilitating Chemistry for the UFS's University Access Programme and am offering tuition in Physical Science Grade 10 - 12. This study aims at understanding factors influencing learners' subject choice. It is a firm belief of mine that learners making more appropriate subject choices can lead lives of better quality.

HAS THE STUDY RECEIVED ETHICAL APPROVAL?

This study has received approval from the Research Ethics Committee of UFS. A copy of the approval letter can be obtained from the researcher.

Approval number: UFS-HSD2017/0134

WHAT WILL HAPPEN TO YOUR CHILD IN THIS STUDY?

Your child will be asked to complete a short questionnaire, taking no more than 20 minutes, at a time that will be negotiated with the school. The aim of the questionnaire is to try and determine whether their choice of subjects are of value to the learner. I will also have access to their marks so as to make a judgement about whether I perceive the learner's choice to be an appropriate one or not. This judgement will be guided by a rubric generated by me and justified by relevant literature. All data and identities will be treated as confidential during the gathering, reporting and storage thereof.

CAN ANYTHING BAD HAPPEN TO YOUR CHILD?

Your child will not be harmed in any way by taking part in this research.

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CAN ANYTHING GOOD HAPPEN TO YOUR CHILD?

There are no known benefits. In future, learners might benefit if we have a better understanding about the relation between learners' real opportunities and the value they attribute to these opportunities. Future programmes / policies could benefit from a better understanding about the way learners think about these opportunities.

WILL ANYONE KNOW YOUR CHILD IS PART OF THE STUDY?

Reporting will be anonymous and all identities - yours, that of your child and the school - will be considered as confidential at all times.

WHO CAN YOU TALK TO ABOUT THE STUDY?

Feel free to contact me with any problems / questions related to this study. My response to e-mails (zettie@kalossits.co.za) are usually better, since most of the day I am teaching and busy in class. Do not hesitate to send an sms / whatsapp to 082 566 8232 - I will address your query as efficiently as possible.

WHAT IF YOU DO NOT WANT YOUR CHILD TO DO THIS?

There will be no problem if you, on behalf of your child, or your child, refuses to complete the questionnaire. Nobody will cause any trouble for you or your child. Participation is voluntary and your choice at all times.

PLEASE RETURN

Name of child: _____

Name of Parent: _____

- Do you understand this research study and are you willing to let your child take part in it? Yes ☐ No ☐
- Has the researcher answered all your questions? Yes ☐ No ☐
- Do you understand that you can withdraw from the study at any time? Yes ☐ No ☐
- I give the researcher permission to make use of the data gathered from my child's participation Yes ☐ No ☐

_____ _____

Signature of Parent ***Date***

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APPENDIX D: ETHICAL CLEARANCE LETTER

UFS·UV

Faculty of Education

24-Jul-2017

Dear **Mrs Elizabeth Venter**

Ethics Clearance: **General self-efficacy as a capability towards appropriate choice regarding Grade 10 Physical Science.**

Principal Investigator: **Mrs Elizabeth Venter**

Department: **Education (Bloemfontein Campus)**

APPLICATION APPROVED

With reference to you application for ethical clearance with the Faculty of Education, I am pleased to inform you on behalf of the Ethics Board of the faculty that you have been granted ethical clearance for your research.

Your ethical clearance number, to be used in all correspondence is: **UFS-HSD2017/0134**

This ethical clearance number is valid for research conducted for one year from issuance. Should you require more time to complete this research, please apply for an extension.

We request that any changes that may take place during the course of your research project be submitted to the ethics office to ensure we are kept up to date with your progress and any ethical implications that may arise.

Thank you for submitting this proposal for ethical clearance and we wish you every success with your research.

Yours faithfully

Dr. MM Nkoane
Chairperson: Ethics Committee

Education Ethics Committee
Office of the Dean: Education
T: +27 (0)51 401 9683| F: +27 (0)86 546 1113 | E: NkoaneMM@ufs.ac.za
Winkie Direko Building | P.O. Box/Posbus 339 | Bloemfontein 9300 | South Africa
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APPENDIX E: SURVEY

Please complete the form below by adding the appropriate information and by marking information which applies to you with an "**X**".

NAME & SURNAME											
DATE OF BIRTH			**GENDER**		**M**		**F**				
ETHNICITY	*Black*		*Indian*		*Coloured*		*White*				
HOUSEHOLD	Both parents still alive:		YES		NO		Number of people in the house:				
	Sharing a house with both parents:		YES		NO		0-3	4-5	6-10	> 10	
PRIMARY LANGUAGE	Afrikaans	English	Ndebele	Northern Sotho	Sotho	Swazi	Tsonga	Tswana	Veda	Xhosa	Zulu

A. Please indicate whether you are doing Physical Science as subject.

YES	NO

B. On the scale below rate your feeling towards your subject choice in relation to PHYSICAL SIENCE:

- If PHYSCICAL SCIENCE is part of your subject choice, rate you feeling towards **taking part** in PHYSICAL SCIENCE.
- If PHYSICAL SCIENCE does not form part of your subject choice, rate your feeling towards **not taking part** in PHYSICAL SCIENCE.

1. I feel my subject choice (taking part / not taking part in PS) has IMPORTANCE in **my life**.

0	1	2	3	4	5	6	7	8	9	10

2. I feel my subject choice (taking part / not taking part in PS) is USEFUL **to me**.

0	1	2	3	4	5	6	7	8	9	10

3. I feel my subject choice (taking part / not taking part in PS) is **to my** ADVANTAGE.

0	1	2	3	4	5	6	7	8	9	10

4. I feel my subject choice (taking part / not taking part in PS) is **to my** BENEFIT.

0	1	2	3	4	5	6	7	8	9	10

C. Read through the items below. Each item has four possible answers. There are no wrong or right answers. Choose the answer you agree with most, and mark the appropriate block with an "**X**".

		Not at all true	Hardly true	Moderately true	Exactly true
1.	I can always manage to solve difficult problems if I try hard enough.				
2.	If someone opposes me, I can find the means and ways to get what I want.				
3.	It is easy for me to stick to my aims and accomplish my goals.				
4.	I am confident that I could deal efficiently with unexpected events.				
5.	Thanks to my resourcefulness, I know how to handle unforeseen situations.				
6.	I can solve most problems if I invest the necessary effort.				
7.	I remain calm when facing difficulties because I can rely on my coping abilities.				
8.	When I am confronted with a problem I can usually find several solutions.				
9.	If I am in trouble, I can usually think of a solution.				
10.	I can usually handle whatever comes my way.				

D. Read through the items below. Each item has four possible answers. There are no wrong or right answers. Choose the answer you agree with most, and mark the appropriate block with an "**X**".

		Disagree Strongly	Disagree Somewhat	Undecided	Agree Somewhat	Agree Strongly
1.						
A	I cope well with academic pressure and challenges.					
B	I do not wish I was studying other subjects (e.g. I enjoy what I am studying).					
C	I am able to "bounce" back from academic setbacks.					
D	I was able to deal with the transition from Grade 9 to Grade 10.					
E	I aspire to succeed in my high school career.					
2.						
A	Learning new things is easy for me.					
B	Grade 8 and 9 equipped me with the skills needed for Grade 10.					
C	I am confident in my ability to learn.					
D	I am fluent in the language of teaching and learning of my school.					
E	I have the necessary resources (textbooks, stationery, mathematical instruments) to do my homework on a daily basis.					
F	I feel that I receive the necessary support from my teachers / school to be able to complete my homework on a daily basis.					
G	I feel confident to speak out and express my views in class.					

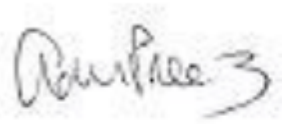
3.		Disagree Strongly	Disagree Somewhat	Undecided	Agree Somewhat	Agree Strongly
A	I feel that enough healthy meals are included in my day to prevent me from losing concentration in class.					
B	Most of the time my health does not prevent me from concentrating in class, doing my homework and studying.					
C	My health does not in any way limit my daily activities compared to most people of my age.					
D	When I am not feeling well I get the support I need from school or my parents / guardians.					
E	My parents / guardians can afford private medical care (a medical aid).					
4.						
A	I feel very safe on the school grounds during school time.					
B	I can afford the school uniform.					
C	I have not been a victim of sexual assault during my high school career.					
D	I have not been a victim of physical harassment during my high school career.					
5.						
A	I can use reasoning to reflect critically on (think about) my values and beliefs.					
B	I can find evidence, examples and reasons to support my views.					
C	When I am learning, I think about what might be, not only about what is.					
D	What I am learning now is extremely important for what I want to be someday.					
E	I am not accepting everything I learn as it is, but I am thinking about it and asking questions about it.					
F	I find pleasure in what I am studying.					
6.						
A	I am not fearful or anxious in learning situations.					
B	I feel that I receive the necessary support from my parents / guardians to be able to complete my homework on a daily basis.					
C	I feel that I receive the necessary support from my teachers / school to be able to complete my homework on a daily basis.					
D	I feel that I receive the necessary support from friends / peers to be able to complete my homework on a daily basis.					
E	At present it is easy for me to enjoy the love, care and support of my immediate family and friends.					
F	Compared to other learners, it is easy for me to show my feelings of love, happiness and gratitude.					
G	Compared to other learners, I do not show much anger and hatred towards people.					
H	At the moment I like most of the people I am sharing my life with and I feel that they support me in what I am doing.					

7.						
A	My idea of a good life is based on my own judgement.					
B	I have a clear plan of how I would like my life to be.					
C	I constantly evaluate how I am leading my life and where I am going in life.					
D	I find it easy to solve problems which I did not anticipate.					
E	I have ideas / skills to provide support to my friends and teachers towards achieving their goals.					
F	My ideas / skills are supporting me to achieve my goals.					
8.						
A	I respect, value and appreciate other people.					
B	I normally meet up with friends or family for a visit or a meal at least once a month.					
C	I find it easy to feel concern towards others or "put myself in the shoes of others".					
D	I find it easy to relate to my peers in the classroom.					
E	I am able to participate successfully in groups for learning.					
9.						
A	I have recently been spending time on recreational activities.					
B	I participate in sport activities at school.					
C	I participate in cultural activities at school.					
D	I have time to participate in other things at school besides school work.					
E	I attend sports meetings / school dances (*sokkies*) at school.					

APPENDIX F: LETTER FROM THE EDITOR

To whom it may concern

This is to state that the dissertation submitted in fulfilment of the requirements for the Masters in Education degree by Elizabeth Petronella Venter titled **Perceived self-efficacy as a factor to realise choice satisfaction regarding post-compulsory Physical Sciences** has been language edited by me, according to the tenets of academic discourse.



Annamarie du Preez

B.Bibl.; B.A. Hons. (English)

21-01-2019